L2 Korean Phonology: the acquisition of stops by English-and Finnish-speaking adults

Kim, Jeong Young

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JEONG YOUNG KIM

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by

Jeong Young Kim

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ABSTRACT

The purpose of this thesis is to find the reason why attaining nativelike pronunciation is difficult in adult L2A. This thesis attempts to take a purely linguistic approach to find it by hypothising that the acquisition of segmental phonology is more than the physical matter of getting the articulators to move correctly and involves phonological rules and principles. The hypothesis was tested through the L2A of Korean stops, which was investigated in three parts; perception of stop segments in word-initial position, production of stop segments in word-initial position and production of stops involving phonological rules constrained by syntax (i.e. the tensification rule vs. the intervocalic voicing rule).

Thirteen British English-speaking adults and fifteen Finnish-speaking adults participated in the experiment. The research subjects were divided into three different groups ('Inexperienced I', 'Inexperienced II' and 'Experienced') according to the length of exposure to Korean. The subjects in the group of 'Inexperienced I' were exposed to Korean for one year in their native countries, and the subjects in the group of 'Inexperienced II' for two years in their native countries. The subjects in the group of 'Experienced' attended a Korean language course for one academic year at least in Korea.

Firstly, as for perception of stop segments in word-initial position, both English- and Finnish-speaking learners performed better in discerning geminates from non-geminate segment in general. Especially, the two language groups of learners were native-like in discerning a geminate (AA) from a non-geminate of which the segment is different from the ones in the geminate (B). On the contrary, the Korean stops distinguished by the feature [sg] alone have appeared the most difficult for the L2 learners of Korean to acquire. The English- and Finnish-speaking learners showed a similar pattern of difficulties in discerning Korean stops regarding the feature [sg]; however, differences between the two language groups were also found in the

perception of word-initial Korean stops, which were caused by the absence or presence of geminate in the learners' L1. On the other hand, no progress was made by English- and Finnish-speaking learners in the acquisition of Korean stops in accordance with the length of exposure to Korean.

Secondly, the production of word-initial stop segments appeared more successful than the perception of them. The difficulty in producing word-initial stops seemed to be caused by Korean-particular phonological representations rather than controlling the degree of VOT values. As for the developmental aspect, English- and Finnish-speaking learners showed the improvement in the segmental production task according to the length of exposure to Korean unlike in the segmental perception task.

Thirdly, the English- and Finnish-speaking learners performed equally poorly on the tensification rule despite the differences in their L1s. One reason was that the learners in both language groups were not advanced enough to sense the interaction between the phonological rule and syntactic condition in the Korean grammar. Another reason was orthographic influence. Regardless of the two language groups' similarly poor results in performance on the tensification rule, it was presumed that only Finnish speakers would be able to acquire the Korean-specific rule with the supposition that positive L1 transfer might occur at the even advanced stages of learning.

In the light of the findings, it was concluded that the hypothesis of this thesis was supported by results from the experiment. Observing that the L2 learners had far greater difficulty in their production of stops involved in the tensification rule constrained by syntax than in their production of word-initial stops, it is concluded that the difficulty of mastering L2 phonology is due to the complexity of phonological rules applying beyond the component of phonology or across phonological domains in the prosodic hierarchy, some of which provide a means for mapping the syntax to the phonology. Therefore, all the complex phonological rules and principles of a segment must be acquired for the target pronunciation.

No part of this thesis has previously been submitted for a degree at Durham University or any other University.

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1. Introduction

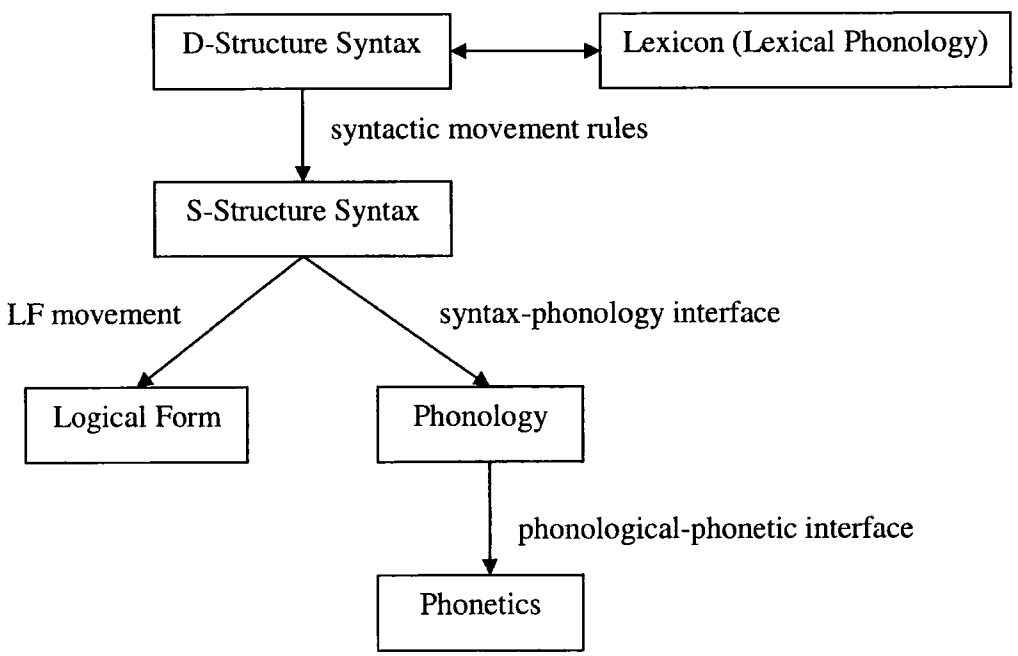
One of the most obvious differences between success in first language (L1) and second language (L2) acquisition is found in phonology (White 1989: 42). For example, Scovel (1969) noted this phenomenon based on a native Polish speaker, Joseph Conrad, who learned English at the age of eighteen, and he stated that Conrad's prose 'demanded almost no grammatical editing, and yet his strong foreign accent prevented him from lecturing publicly in English (p. 247).' The difficulty of the L2 acquisition of pronunciation has been investigated via the 'Contrastive Analysis' (CA), which was introduced by Lado (1957). Contrastive analysis of phones has been adopted by many other researchers in the area of L2 phonology. In particular, numerous studies by Flege and his colleagues have exploited voice onset time (VOT) values in order to acoustically measure the differences among 'similar' phones and show the gap between their L1 and L2 VOT values, which, they assume, may be one of the reasons for the difficulty of L2 pronunciation mastery. But they do not provide satisfactory phonological explanations to answer the question why adult L2 learners do not normally attain the native-like pronunciation. A CA type of analysis fails to predict level of difficulty or order of acquisition. Eckman (1977) attempted to overcome the failure by proposing Markedness Differential Hypothesis (MDH). However, the MDH did not seem to be effective in explaining the L2A of syllable structure as opposed to segments (Sato 1984, Anderson 1987, Major 1996).

Recently, Brown (1998, 2000) has attempted to deal with the phoneme contrast between L1 and L2 through featural analysis, for which she employed the theory of

'Feature Geometry'. Still, her studies have been restricted to phonemes themselves and their positions in a syllable, where no further rules were involved.

The acquisition of phonemes alone does not guarantee their correct production. Various factors must be attributed to the mystery of the difficulty of attaining native-like L2 pronunciation, and it is important to note that 'the acquisition of phonology involves the interaction of a number of innate principles with the input, leading to the highly complex internal organisation of a specific phonology in the adult's mind/brain' (cited from Hannahs and Young-Scholten 1997: 3). I assume in this thesis that the syntax-phonology dichotomy such as the case of Joseph Conrad may occur owing to the characteristics of the complexity of phonological rules and principles interfacing with other components of the grammar, for example (surface structure) syntax.

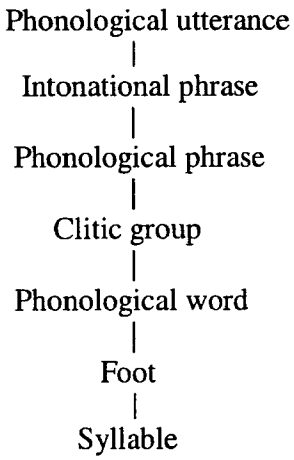
(1.1) An enriched version of models proposed by Chomsky and Halle (1986: 68), Selkirk (1984: 2), and van Riemskijk and Willams (1986: 310): Copied from Silva (1992: 2)



As we see in (1.1), phonology involves most of the grammatical components in the mind, from the inmost level (lexical phonology) to the surface level (phonetics), unlike the other grammatical components. At the inner level, lexical phonology interacts with D-structure syntax. S-structure syntax interfaces with phonology, and phonology with phonetics.

The notion of phonology-syntax dichotomy in adult L2A can be elaborated better by the hierarchy of prosodic constituents proposed by Nespor and Vogel (1982, 1986). According to Nespor and Vogel, phonological constituents are seen as a hierarchically arranged set of phonological domains. These constituents are the syllable, foot, phonological word, clitic group, phonological phrase, intonational phrase and phonological utterance as illustrated in (1.2). Some of these phonological or prosodic constituents are based upon structures found in other components of the grammar (e.g. the syntax) and thus provide a means for mapping the syntax to the phonology.

(1.2) The prosodic hierarchy (Nespor and Vogel: 1982; 1986)



Phonological constituents define the domain of application of phonological rules, which can be classified as domain span rules (applying whenever their structural descriptions are met within a given prosodic constituent), domain limit rules (applying when their structural descriptions are met at the edge of a given constituent) and domain juncture rules (applying when their structural descriptions are met at the juncture between two constituents of the same type). The various prosodic constituents are constructed on the basis of phonological, morphological and syntactic information. With regard to the prosodic aspects of L2 phonology, Young-Scholten (1993) stated as below and employed the phonological hierarchy in her study in order to unravel the question of difficulties in attaining native-like phonology.

> "Acquisition of prosodic structure in a second language has received considerably less attention than the acquisition of segments; even less attention has been paid to those prosodic factors which might conspire to result in incomplete acquisition. Prosodic structure includes syllable structure as well as rhythm, pitch, intonation and the assignment of stress. The application of phonological rules across word boundaries can also be subsumed under prosodic structure. ... The anecdotal accounts of advanced second language learners who speak 'too perfectly' point to the likelihood that such learners do not acquire the post-lexical application of phonological rules in their second language. Such accusation indicates the second language learner's tendency to limit the application of phonological rules to the domain of the word (i.e. lexically)."
> (Young-Scholten 1993: 3-4)

Young-Scholten (1993) pointed out that incomplete acquisition of L2 phonology might be due to the L2 learners' tendency to limit the application of phonological rules to the domain of the phonological word when the required domain is larger.

Inspired by the remarks made in Young-Scholten (1993) and Hannahs and Young-Scholten (1997), this thesis hypothesises that the acquisition of segmental phonology is more than the physical matter of getting the articulators to move correctly and it involves phonological rules and principles not only on the segmental and lexical levels but also on the prosodic and postlexical levels. Here is where L2 learners have difficulties attaining native-like phonology. I also presume that the acquisition of adult L2 phonology may be affected more strongly by the phonological representation of even an individual phonemic segment than by articulatory motor skills. Phonemes are always influenced according to the phonological and also the syntactic environment. In order to look at the issue of L2 phonological difficulty, I intend to look at phonemes constrained by syntactic conditions as well as by purely phonological conditions. By doing so, it is expected to achieve the goal of this study which shows why the mastery of L2 phonology is so difficult.

The acquisition of Korean stops by British English speakers and Finnish speakers has been chosen for this study based on the consideration of Lado's (1957) classic work, maximum learning difficulty. According to Lado, Phonological Learning Difficulty is "the kind of problem in which part of a phoneme in the native language can pass as a separate phoneme in the foreign language, and other parts of the same native-language phoneme pass as a different phoneme in the foreign language; that kind of problem is by far the most difficult to overcome" (p. 15).

In Chapter 2, previous studies on adult L2 phonology, particularly regarding segmental acquisition, are reviewed with regard to three topics: (i) perception of segments, (ii) production of segments and (iii) prosodic phonological rules constrained by

syntax. In the review, Brown (1998, 2000) is focused on for the topic of perception of segments in light of Feature Geometry; Flege and Hillenbrand (1984), Flege and Eefting (1987) and Flege (1987) for the topic of production of segments in regard to laryngeal processes, voice onset time (VOT) and phonological representations; and lastly, Young-Scholten (1994, 1997) for the topic of prosodic phonological rules constrained by syntax.

In Chapter 3, an overview of Korean stops, the target sounds in this study is provided in comparison with English stops and Finnish stops. We will first see how Korean stops are different from English and Finnish stops concerning their phonological representation as independent sound units. Then, phonological rules applying to noun + noun compounds in the three languages will be examined with regard to geminates and gemination of stops. In particular, the tensification rule in Korean is contrasted with the intervocalic voicing rule so that difficulty in acquisition of the prosodic (and/or postlexcial) rule can be examined in a comprehensive way. By comparing Korean stops and phonological rules with the subjects' L1 stops and the phonological rules pertaining to them, predictions for the success or failure of the acquisition of Korean stops by English and Finnish speakers are given. The Korean orthographic symbols of the three distinctive stops are also presented in order to discuss the relation between the written symbols and stop sounds, which is predicted to further affect the L2A of Korean stops.

In Chapter 4, the methods and materials for the present study are described. First, details of the thirteen English- and fifteen Finnish-speaking subjects are provided, with mention of ten native Korean speakers as the control group. Then, the task materials, methods of data collection, rationale for each of the three tasks (i.e. stop discrimination, picture naming and flash card reading) and the analysis of the collected data are described.

In Chapter 5, results of the three tasks are separately presented in three subsections: 'Perception of Stops', 'Production of Stops' and 'Tensification vs. Intervocalic Voicing'. Individual results for all subjects and development in the acquisition of Korean stops are discussed within each group, and results between groups are also compared to discuss with regard to the predictions for L2A of Korean stops suggested in Chapter 3. Korean stops are dealt with as segments in word-initial position in the subsections of 'Perception of Korean Stops' and 'Production of Korean Stops'. Before moving to 'Tensification vs. Intervocalic Voicing', the relation between perception and production of utterance-initial Korean stops is briefly discussed in consideration of previous L2 studies on perception and production. In the subsection of 'Tensification vs. Intervocalic Voicing', the tensification rule in contrast with the intervocalic voicing rule constrained by syntactic conditions on the prosodic (and/or postlexical) level is the main issue. Thus, allophonic variations of plain stops, appearing either as a tensed sound (as the result of gemination) or as a voiced sound, are focused for the discussion. Orthographic influence is then taken into account to analyse the data collected from the task of reading flash cards.

Chapter 6 summarises the findings with respect to the hypotheses of the present study and concludes that the difficulty of adult L2 phonology is due not only to the physical matter of getting the articulators to move correctly for the target pronunciation of a single segment but also to a number of phonological rules involving syntactic conditions, which are nested in the prosodic hierarchy of phonological domains as shown in (1.2).

An appendix follows with the materials used in the experiment (the Yale System Romanisation adopted to Romanise Korean letters), the form of questionnaire and individual raw results.

2. Previous Studies on the Acquisition of Segments in L2A

Early studies on segmental acquisition in L2A are traced back to Contrastive Analysis Hypothesis (CAH) introduced by Lado (1957). In his book, *Linguistics Across Cultures*, he assumed that the difficulty in acquiring L2 phonemes was caused by phonemes which do not exist in learner's native language (According to Flege (1987), those phonemes are called 'new'; see below). Lado claimed that the more persistent difficulty was caused by simple transfer of 'similar' phonemes from the learner's L1 to L2. He described that similar phonemes were the sounds that are physically similar to those of the native language, that structure similarly to them and that are similarly distributed (p.12).

The concept of 'new' and 'similar' has been adopted in many studies on the acquisition of L2 pronunciation (e.g. Flege 1987, 1989, 1993 and 1997, Kim and Major 1996). With his acoustic experiments measuring voice onset time (VOT) values, Flege elaborated the notion of 'new' and 'similar'. In Flege (1987), he stated that 'new' L2 phones have no counterpart in the L1 and so, by definition, differ acoustically from phones found in the L1 and 'similar' L2 phones, on the other hand, differ systematically from an easily identifiable counterpart in the L1. For instance, /y/, /u/ and /t/ in English and French were taken as the examples to explain the notion of 'new' and 'similar'. Flege (1987: 48) states for the examplary phones that realisations of French /y/ are 'new' phones for native speakers of English because English has no /y/ category although [y] phones may sometimes occur on the phonetic surface of American English as an allophone of /u/ (as in [mjyzIk] for "music"). As for the case of 'similar', /t/ is found in

both French and English, but it is implemented as a short-lag stop with dental place of articulation in French, and as a long-lag stop with alveolar place of articulation in English. He further stated that the /u/ of French and English must also be classified as similar, for /u/ is realised with somewhat higher and more variable second formant (F_2) frequencies in English than French. Yet, the elaboration on the notion of 'new' and 'similar' in Flege's contrastive acoustical studies does not seem to provide a predictive phonological explanation for the difficulty of L2 phonology but rather exploit acoustic measurements to show the difference between L1 and L2 phones.

Likewise, in the earliest work in contrastive phonology (e.g. Lado 1957, Richards 1968), the lack of predictive ability was identified as a major problem for a theory of L2 phonology. To solve the problem of the CAH, typological markedness termed as 'Markedness Differential Hypothesis (MDH)' was employed in Eckman (1977), in which 'markedness' is defined as a phenomenon that A in some language is more marked than B if the presence of A in a language implies the presence of B; but the presence of B does not imply the presence of A. The MDH takes into account both L1 transfer and language universals. The hypothesis states that forms in the L2 that differ from and are more *marked* than L1 forms will be difficult to learn, and that the relative degree of difficulty will correspond to the relative degree of markedness. The aspects of the target language that are different but *unmarked* will not be difficult to learn. In this view, a phenomenon A in some language is considered to be more marked than a phenomenon B, "if the presence of A in a language implies the presence of B, but the presence of B does not imply the presence of A." (p. 320) To illustrate this notion of markedness, Eckman uses the example of voiced versus voiceless stops. There are languages such as Korean that

have only voiceless stops, and there are languages such as English that have both voiced and voiceless stops. However, there are no languages that have only voiced stops. Thus voiced stops always imply the presence of voiceless stops and are thus said to be more marked (or less natural) than voiceless ones. The hypothesis, then, would predict that a voiceless stop would be easier for the L2 learner to acquire than its voiced counterpart, if neither occurred in the L1 of the learner. Consequently, he claimed that the MDH, which incorporates certain markedness relations from universal grammar, is superior to the CAH in predicting the areas of difficulty a language learner will have. (p. 66)

By means of the MDH, there were attempts to predict syllable structure difficulty (Anderson 1987; Major 1996). For example, Anderson (1987) tested native Arabic and Chinese learners of English on the length of clusters and their positions in English syllables. The length of time the subjects had been in the United States varied from five to sixty months. Not all the MDH predictions were borne out in the study. For the Arabic group, no difference in performance had been predicted between the marked final clusters and the unmarked initial ones because the two determinants implicit in the MDH – native language transfer and markedness – had made the opposite predictions and thus cancelled each other out. Thus no differences in difficulty were predicted. Yet the results showed that unmarked forms (initial clusters) were easier, indicating that the universal factor implicit in the hypothesis overruled the transfer factor. Thus he concluded that the MDH might have to be modified to make a stronger statement about the power of its universal determinants. Major (1996) also examined the L2A of consonant clusters in initial and final positions of a syllable structure. The subjects were adult native speakers of Portuguese who were learning English at the beginning level in

Rio de Janeiro. With regard to markedness, he remarked that "there was some ambiguity as to what certain markedness relationships are. (p.93) In sum, the MDH may have found some support in studies of phonology (Anderson 1983, Carlisle 1988, 1991); however, Sato (1984) has provided some apparent counter evidence in a syllable structure study.

More recently, Brown (1998, 2000) adopted the theory of Feature Geometry in L2A of segments. Her works efficiently predicted the difficulty of L2A of word-initial segments but not of word-medial and -final ones. Such a lack of the explanation of the L2 acquisition of segments in different positions strongly suggests that attaining the native-like phonology is not merely acquiring L2 segmental sounds per se but also relevant phonological rules.

A number of researchers have approached, on the other hand, L2 phonology at the suprasegmental level from autosegmental, metrical, CV, and lexical phonology perspectives (see Goldsmith 1990). Broselow (1985), in a production and perception study of Arabic learners of English, found that by employing principles of metrical phonology she could explain the patterns of Arabic speakers breaking up consonant clusters. Furthermore, she claimed that L2 substitutions could provide new evidence for testing general linguistic hypotheses. In various works, James (1986, 1987, 1988, 1989, and 1990) has employed nonlinear approaches. For example, James (1987) used metrical phonology to map out the prosodic structure of Dutch learners of English; in James (1990) he proposed a model of L2 phonological acquisition using autosegmental notions of the skeletal tier and parameter setting. Carlisle (1991), in examining vowel epenthesis in the environment /sC/ in Spanish speakers of English, used CV phonology (Clements & Keyser 1983) to account for the more frequent epenthesis after word-final consonants

than after final vowels. Archibald (1992) utilised metrical parameters similar to those used by Carlisle to account for Polish speakers' stress assignment in English. Also, Pater (1997) examined metrical parameter missetting in second language acquisition via French learners' knowledge of English word stress. Archibald (1998), in particular, discussed the acquisition of segments, syllables, moras, and metrical structure and the interaction of those phonological domains, focusing on the necessity of some sort of hierarchical constituent structure to account for L2 phonology. Meanwhile, Vogel (1991) used Italian speakers of English as evidence for issues in prosodic phonology. Zampini (1997), which presented an analysis of the L2 phonological acquisition of Spanish voiced stop spirantization in post-vocalic position by native speakers of English, suggested an order in the acquisition of phonological domains that obeys the prosodic hierarchy (Selkirk 1980, Nespor & Vogel 1982, 1986). She also provided evidence for the Clitic Group as a domain relevant in L2A in this hierarchy, and formed the basis for the establishment of an interlanguage rule grounded in the tenets of phonological theory. As for L2A of post-lexical phonology, a number of Young-Scholten's (e.g. 1992, 1993, 1994, 1997) studies have investigated the L2A of phonology with respect to phonological interface with syntax.

Among works dealing with the L2A of phonology, the studies mentioned as follows are brought to our special attention so that results of the present study will be discussed in consideration of them: Brown's (1998, 2000) for the issue of perception of segments; Flege and Hillenbrand (1984), Flege (1986) and Flege and Eefting (1987) for the issue of production of segments; and Young-Scholten (1994, 1997) for the issue of prosodic phonological rules constrained by syntax.

2.1. Perception of Segments

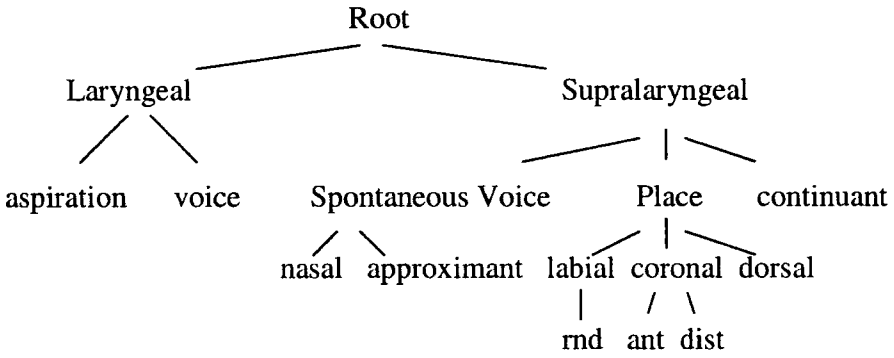
I assume that the feature representations associated with segments are the main cue to distinguish contrasts. Therefore, this section contains an outline of the theory of Feature Geometry, which systematically explains phoneme contrasts by features, and some examples of distinctive feature representations in the frame of Feature Geometry are followed by summaries of Brown's two recent studies.

2.1.1. Feature Geometry

The theory of segmental representation known as Feature Geometry appears effective to explain not only phonetic but also phonological phenomena in language acquisition (Archibald 1998; Avery and Rice 1989; Brown 1993, 1995, 1998, 2000), as it is contained in the phonological component of Universal Grammar, the innate language faculty ascribed to the child by generative theorists. Feature Geometry is regarded to constrain the acquisition process by providing the learner with information about what phonemic oppositions are possible in natural languages. (Brown 2000: 12) In order to explain the characteristics of each phoneme and distinguish them from each other, phonetic features are required. The phonetic features are not unordered feature bundles as in Chomsky and Halle (1968), but are internally structured (see (2.1)) and eventually grouped into a systematic hierarchy of segmental subconstituents (Clements 1985; McCarthy 1988; Sagey 1986). The feature geometry of each segment is unique and thereby distinguishes itself from other segments. However, a feature geometry should minimally specify relevant phonetic features. According to Minimally Contrastive Underspecification, a segmental representation consists of only the information required

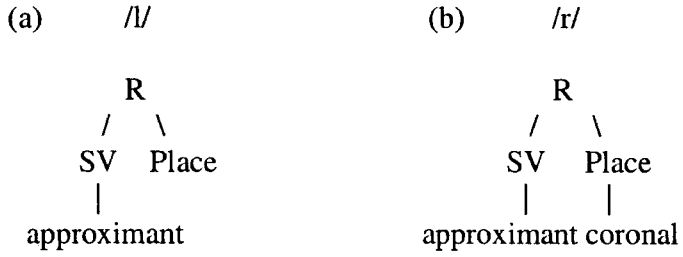
to contrast it from all other segments in the system; any further specification will be added by a system of phonetic implementation (Avery and Rice 1989). For example, in English, the contrast between lateral approximant /l/ and central approximant /r/ is represented by the feature [coronal] as shown in (2.2) (Piggott 1993; Brown 1993, 1995, 2000). On the contrary, the languages which do not have the phoneme contrast of [l] and [r] such as Japanese and Korean, do not have distinct representation. Thus, [l] and [r] are not different phonemes but allophones of a single phoneme in Japanese and Korean. Brown claims that the feature [coronal] does not play the role to make a distinction between approximants in the Feature Geometry in Japanese and Korean unlike in Chinese. That is why Japanese and Korean learners of English have difficulties in learning the correct pronunciation of English /l/ and /r/ whereas Chinese learners of English do not.

(2.1) A model of Feature Geometry (from Brown 2000: 12)



*Glossary: rnd=round, ant=anterior, dist=distributed

(2.2) Segmental representations for English /l/ and /r/ (from Brown 2000: 22)



2.1.2. Brown (1998)

In order to look at the acquisition of /l-r/ contrast in English with regard to their L1 feature representations, Brown tested three language groups in the first experiment: ten Chinese speakers, ten Japanese speakers and ten monolingual speakers of American English as the control group. In an AX discrimination task, the subject heard a minimal pair, one item containing an /l/ and the other item containing an /r/, and was asked to indicate whether the words are the same or different (e.g. lip-rip). And in the picture selection task, the subject was presented with two pictures as well as a verbal cue that corresponds to one of the pictures. For example, the subject saw pictures of a rake and a lake and had to indicate which of the pictures the verbal cue named. She tested the /l-r/ contrast on the onset, cluster and coda positions respectively (e.g. lock-rock, clown-crown and ear-eel) in this experiment.

Chinese subjects accurately performed both of the two tasks over 90% of the time for all experimental conditions. On the contrary, the Japanese speakers' performance was roughly 30% correct on the auditory task and roughly 60% on the picture task for the onset and cluster positions. As for the coda position, Japanese speakers were also almost perfect, scoring 99.3% for the auditory task and 92.5% for the picture task. Supported by

the results from the two tasks, she argued that a speaker might be able to perceive a non-native contrast if the feature that distinguishes the two segments is present in his or her L1 feature geometry despite the fact that that feature is not utilised in the representation of native member of the contrast in question.

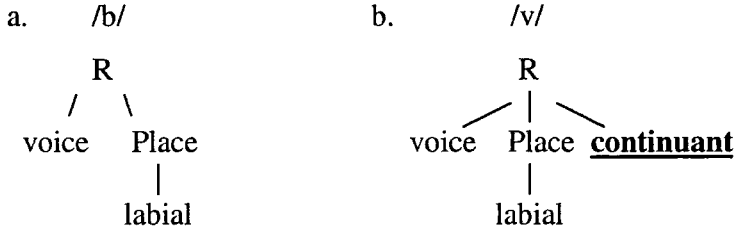
The feature that distinguishes the lateral approximant /l/ from the central approximant /r/ is [coronal] in English, as shown in (2.2). Although Chinese has a single liquid /l/ like Japanese, Chinese requires [coronal] in the representation of certain other phonemes whereas Japanese does not. That is, Chinese includes the distinctive feature [coronal] and they utilise it for the /l-r/ discrimination in their L2 acquisition. In contrast, [coronal] is not included at all in Japanese phoneme inventory, owing to which Japanese subjects who had been exposed to English even before puberty (e.g. 10 years old) were not able to discriminate between the two sounds. Moreover, she claimed that it is the [coronal] rather than [lateral] that makes the distinction between /l/ and /r/, on the ground that Korean speakers' perception and phonological discrimination of the /l-r/ contrast resembles Japanese speakers' performance on these two tasks, which was supported by evidence in a subsequent study.

She further tested the results from the first experiment by comparing the acquisition of non-native contrasts which differ with respect to whether the relevant feature exists in the L1 grammar of a homogeneous group of speakers. For the extended test, she proposed that if a learner's L1 grammar lacks the phonological feature that differentiates a particular non-native contrast, he or she will be unable to perceive the contrast and therefore unable to acquire the novel segmental representations. In order to evaluate this hypothesis, the second experiment compares the acquisition of the English

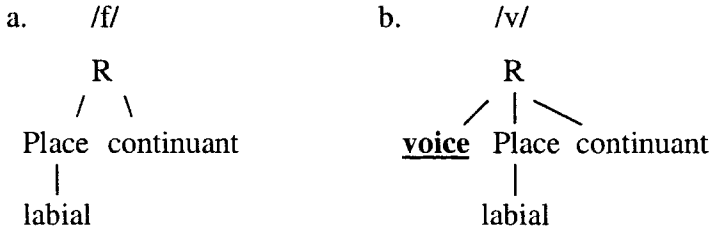
/l-r/, /b-v/, /f-v/ (non-native contrasts) and /p-b/ (a native contrast) contrasts by Japanese speakers. The native /p-b/ contrast was included for comparison with the non-native contrasts. Fifteen Japanese were tested with fifteen English speakers of the control group in the second experiment. For Japanese speakers, the reported age of first exposure to English ranged from four years old to thirteen years old. Each subject had studied English in school in Japan for a minimum of six years, up to a maximum of ten years, and the length of time these subjects had been continuously living in North America ranged from one month to five years.

The tasks used in the second experiment were the same as those used in the first experiment. In the auditory task, Japanese subjects scored 95% on the control items (i.e. native /p-b/ pairs) and 90% and 96.1% on /b-v/ and /f-v/, respectively. And in the picture task, they accurately performed 88.9% on /b-v/, 96.7% on /f-v/ and 93.9% on p-b/. Still, their performance on /l-r/ contrast was poor, where they scored 35.6% in the auditory task and 52.7% in the picture task. The experiment, therefore, supported the proposal that the presence of the features [continuant] and [voice] in the Japanese grammar permits these speakers to perceive the contrast between /b/ and /v/ and between /f/ and /v/, respectively (see (2.3) and (2.4)).

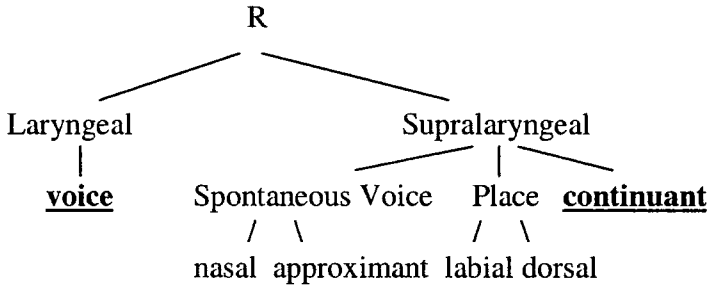
(2.3) Segmental representations for English /b/ vs. /v/ (from Brown 1998: 176)



(2.4) Segmental representations for English /f/ vs. /v/ (from Brown 1998: 176)



(2.5) Japanese Feature Geometry (from Brown 1998: 177)



Consequently, she strongly suggested that the distinctive features manipulated in the L1 grammar are a more important factor in the acquisition of non-native phonemic contrasts than whether the L1 inventory contains either member of the non-native contrast.

2.1.3. Brown (2000)

This study as the extension of Brown (1998) investigated how the grammars of Japanese speakers, Korean speakers and Mandarin Chinese speakers affect their acquisition of English contrasts and whether, given the necessary conditions, novel segmental representations can be constructed. Three types of tasks (AX discrimination task, 4IAX discrimination task and forced choice selection task) were used for the experiments. The AX discrimination task and forced choice selection task were the same

as the tasks used in the experiments in Brown (1998). In 4IAX discrimination task, each trial consists of two pairs of words (Pisoni 1971); in one of those pairs, the two words will be different (i.e. a minimal pair), and the other pair of words will be the same (e.g. ra-ra, la-ra). The subject's task is to indicate which of the two pairs of words is different. The stimuli to this task were CV syllables; that is, non-words in order to prevent the subjects' perception from being influenced by their familiarity with particular lexical items (Yamada, Kobayashi and Tohkura 1997).

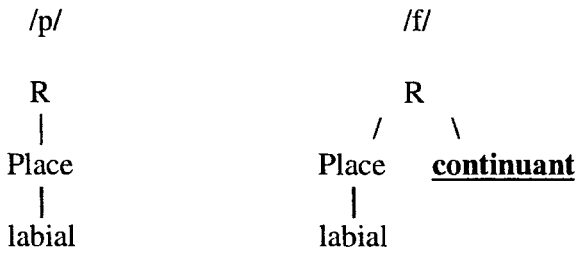
In one of the two new[1] experiments in Brown (2000), the English /l-r/, /b-v/, /p-f/, /f-v/ and /s-θ/ contrasts were tested on 15 native Mandarin Chinese, 15 Japanese and 11 Korean speakers including 10 native monolingual speakers of American and British English in Hokkaido, Japan. The phonemic contrast pairs were chosen to test the proposed model of phonological interference because these pairs are not contrastive in Chinese, Japanese or Korean. The 4IAX discrimination task (the auditory performance) and forced choice picture selection task (the picture performance) were used for the experiment. The results from the two tasks were not very different from each other. Since the task used in my study, as we will see, is similar to the 4IAX discrimination task, I will focus on the results from the auditory performance.

Starting with the Chinese group, they were equally good at discriminating the /p-f/, /f-v/ and /l-r/ contrasts, and with the same accuracy with which they distinguished their native /p-t/ contrast; they discriminated all of these contrasts significantly better than they did the /s-θ/ contrast [$F(14, 60)=8.55$, $p= .0001$]. Brown had expected this because the former non-native contrasts are distinguished by a feature contained in the Chinese

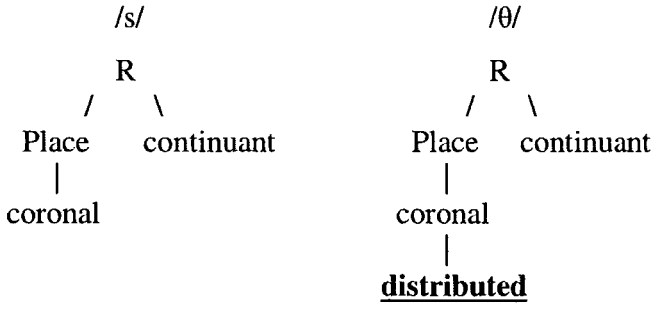
[1] Brown (2000) conducted three experiments. 'Experiment 1', one of the three had been introduced earlier in Brown (1998) as 'Experiment 2'.

grammar, whereas the latter is not. The Japanese group, too, discriminated the /p-f/ and /f-v/ contrast with the same accuracy that they discriminated their native contrast, and they were significantly better at perceiving these contrasts than the /s-θ/ or /l-r/ contrasts [F (14, 60)=29.78, p= .0001]. These speakers did not, however, perceive the /s-θ/ and /l-r/ contrasts equally poorly; their discrimination of /l-r/ was worse than their discrimination of /s-θ/. She found a similar pattern with the Korean speakers: /l/ and /r/ were discriminated less accurately than /s/ and /θ/ and performance on both of these contrasts was significantly worse than on the other contrasts [F (10, 44)=9.06, p= .0001]. It was also noted that Japanese speakers and Korean speakers differed from Chinese speakers in their ability to discriminate /l/ and /r/. Hence, the presence of the feature [coronal] in the grammar of Chinese speakers ensures that acoustic stimuli which differ on this dimension would be perceived as distinct, whereas the absence of the feature from the Japanese and Korean grammars causes the acoustic signal for these two sounds to be funnelled into a single perceptual category. On the other hand, the absence of the relevant feature [distributed] from all three L1s accounts for learners' uniform inability to acquire the /s-θ/ contrast (see (2.7)).

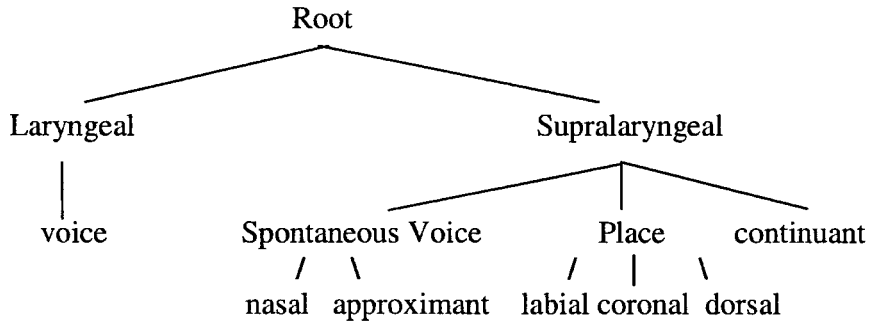
(2.6) Segmental representations for English /p/ vs. /f/ (from Brown 2000: 22)



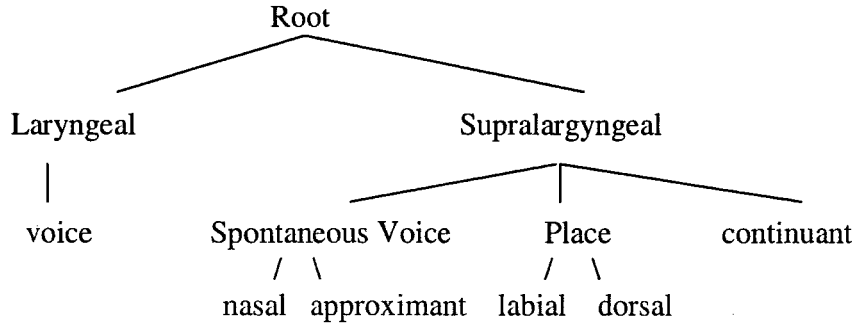
(2.7) Segmental representations for English /s/ vs. /θ/ (from Brown 2000: 22)



(2.8) Chinese Feature Geometry under investigation (from Brown 2000: 25)



(2.9) Korean Feature Geometry (from Brown 2000: 25)



In the other experiment in Brown (2000), data were collected from 35 native speakers of Japanese and 10 native speakers (American, British and Canadian English teachers) of English in Hokkaido, Japan. This experiment was conducted in order to determine whether the influence of the native grammar on the perception of non-native contrasts changes over time as the L2 learner progresses. The 35 Japanese speakers were divided into two groups: 20 in the low-level and 15 in the high-level. The learners in the low-level had studied English for 7.6 years in average and those in the high-level for 11.5 years. The AX discrimination task and forced choice picture selection task were used to test /l-r/, /b-v/ and /p-b/ contrasts in this experiment. She used the AX discrimination task (auditory performance) to assess perception and the forced choice picture selection task (picture performance) to assess phonological competence.

Although her purposes for the two tasks were different from each other, the results from them showed a similar pattern to each other in a sense that the both groups of Japanese learners were better at distinguishing the /b-v/ contrast than the /l-r/ contrast. Also, both the low-level and high-level groups showed near perfect performance on the control items of native /p-b/ pairs. Both groups of Japanese speakers were significantly worse than the English controls at discriminating the /l-r/ contrast [$F(2,44)=74.49$, $p= .0001$]. However, there was no difference between the low-level and high-level groups in their ability to discriminate this contrast; learners in both groups were equally unable to perceive the difference between /l/ and /r/. Thus, an increase in English proficiency did not appear to affect perception of this non-native contrast. Accordingly, she claimed that accurate perception was blocked by the native grammar in the earliest stages of acquisition and continues to prevent perception even as the learner progresses.

As for the /b-v/ contrasts, there was no difference between the high-level and the control groups' performance [F(2,44)=9.79, p= .0003], while the learners in the low-level group were not as accurate at discriminating the /b-v/ contrast as those in the high-level group. In short, whereas the ability to accurately perceive the /l-r/ contrast did not improve over time, the ability to perceive the /b-v/ contrast did improve, from being fairly good to being native-like.

Thus, she concluded that when the relevant feature is absent from the native grammar, as it is in the case of /l-r/, and perception is blocked, the effect of the grammar remains constant. However, if the relevant feature is present in the native grammar, as it is for /b-v/, then the effect of the grammar may change.

2.2. Production of Segments

Could production of segments be predicted in the identical way as Brown examined for the perception of segments? To my knowledge, there has been no such equivalent research dealing with production of segments to Brown's perception studies. However, there have been studies on L2 stop production in which VOT values of L2 stops in the word-initial position are measured so as to compare them with those of L1 stops in the same position (e.g. Flege & Hillenbrand 1984, Flege & Eefting 1987, and Flege 1987). They report that L2 learners failed to produce authentic VOT values of the target sound although the VOT values produced as L2 differed from the corresponding sounds in the learner's L1.

In this section, Flege and his colleagues' acoustic studies on L2 segmental production are summarised in order to discuss how VOT values (which may be regarded

as a physical matter) can affect the L2 word-initial segmental production in comparison with phonological/mental representations in adults' brain/mind in Chapter 5.

2.2.1. Flege and Hillenbrand (1984)

Flege and Hillenbrand (1984) hypothesised that L2 phones which differ acoustically from easily identifiable counterparts in L1, but are nonetheless judged to be realisations of the same category as the L1 phones (called "similar phones"), cannot be produced authentically[2] by L2 learners because of equivalence classification. Flege (1986) tested this hypothesis in a study which rested on the assumption that (for example) French speakers of English judge tokens of [t] in French words and [t^h] in English words to be realisations of a single category (i.e. {t}). Acoustic analyses showed that experienced native French speakers of English (and also English speakers of French) realised /t/ with significantly different VOT values for the L1 and L2. They, therefore, suggested that the subjects had noted at least some of the acoustic differences distinguishing the short-lag dental [t] used to realise /t/ in French from the long-lag alveolar [t^h] in their realisation of /t/ in English. However, the French subjects realised English /t/ with significantly shorter (French-like) VOT values than English monolinguals; and the native English subjects realised /t/ in French words with longer (English-like) VOT values than French monolinguals.[3]

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[2] Their use of the term "authentic" refers to statistically significant acoustic differences between subject groups. For example, a group of L2 learners is said to produce L2 phone "non-authentically" if they differ significantly from a group of native speakers in terms of measured VOT values. However, Flege & Hammond (1982) and Flege (1984) suggested that small VOT differences are auditorily detectable.

[3] The findings of the studies that L2 learners were unable to realise English /p, t, k/ authentically may be due to the age at which the subjects examined began learning English. Fokes, Bond & Steinberg (1985) found that native Arabic-speaking children aged 2-11 years realised /p, t/ in English words with English-like VOT values (82ms). Although the Arabic-speaking children's speech production was not compared to that of age-matched native English-speaking children, this suggests that they may have approximated the

2.2.2. Flege and Eefting (1987)

Flege and Eefting (1987) further tested the hypothesis of Flege (1986) and Flege and Hillenbrand (1984) that L2 learners cannot realise /p, t, k/ authentically in L2 if they are implemented with a different phonetic category in L1 and L2. Flege and Eefting examined production of /b, d, g/ and /p, t, k/ in the initial position of English and Spanish words by two groups of native Spanish adults at mean age of 19 years and native Spanish 9-10 year-olds who began learning English as a second language by the age of 5-6 years. One group of native Spanish adults were later childhood bilinguals (LCB), who were born and raised in Puerto Rico of native Spanish parents and had never lived in an English-speaking environment. The subjects in LCB began learning English at the age of 5-6 years upon entering a private elementary school, where they were enrolled for an average of 7.1 years. The other group of native Spanish adults were earlier childhood bilinguals (ECB), who were born in the U.S.A. or had been taken there shortly after birth. The subjects in ECB had lived for an average of 9.7 years in the U.S.A. and were enrolled for 6.4 years in an English-speaking elementary school there. The subjects in all three groups produced /p, t, k/ with significantly longer VOT values in English than Spanish words, but with significantly shorter VOT values in English words than age-matched English monolinguals. The subjects also realised Spanish /p, t, k/ with significantly shorter VOT values than age-matched Spanish monolinguals.

VOT norm of English more closely than adult L2 learners in the studies of Flege & Hillenbrand (1984) and Flege (1986).

2.2.3. Flege (1987)

In Flege (1987), acoustic measurements were made of the VOT in French and English words spoken by native French subjects who were highly experienced in English, and by three groups of native English subjects differing according to French-language experience. The speech of monolingual subjects was also examined to estimate the phonetic norms of French and English. The L2 subjects in all four groups produced /t/ in their L2 with mean VOT values that either closely resembled the L1 phonetic norm, or were intermediate to the phonetic norm for VOT in L1 and L2. L2 learning was also shown to influence production of /t/ in the L1. The native French subjects who spoke English produced French /t/ with longer (i.e. English-like) VOT values than French monolinguals and the most experienced native English speakers of French produced English /t/ with shorter (French-like) VOT values than English monolinguals.

Flege and Port (1981) compared phonetic implementation of the stop voicing contrast (i.e. /p-b/, /t-d/, /k-g/) produced in Arabic by Saudi Arabians and by both Americans and Saudis in English. The English stops produced by Saudis manifested temporal acoustic correlates of stop voicing (VOT, stop closure duration and vowel duration) similar to those found in Arabic stops. Despite such phonetic interference from Arabic to English, however, American listeners generally had little difficulty identifying the English stops produced by the Saudis, with the exception of /p/, which is absent in Arabic. Williams (1979), on the other hand, found that 8-10 and 14-16 year-old native Spanish (Puerto Rican) children produced English /p/ with Spanish-like mean VOT values of about 40 and 20 ms, respectively. These values were probably suggesting that even child L2 learners might not realise L2 stops authentically.

Observing some previous acoustic studies focusing on L2 stop VOT values, I have drawn two inferences below, which will be exploited in analysing my own data later.

- VOT values produced by adult L2 learners may remain intermediate to the phonetic norm for VOT in L1 and L2.
- The intermediate VOT values produced by adult L2 learners may be closer to their L1's than to the L2's.

However, unlike the previous studies, the present study will not measure the VOT values in the experiment so as to compare them with those from native Korean speakers. The interest of this study does not lie in the difference of VOT values between native Korean speakers and L2 learners but is to investigate if L2 learners of Korean are able to distinctively produce the three types of Korean stops regardless of the fact that their L1 has two-way stop distinctions.

2.3. Prosodic/Postlexical Phonological Rules Constrained by Syntax

Reviewing Brown's and Flege and his colleagues' studies in Sections 2.1 and 2.2, we have learned that both the phonological representations and VOT values can be involved in acquisition of word-initial segments. Then, would L2 word-initial segments (whether they are correctly produced or not) remain the same across word boundaries? Or would they take a different form from utterance-initial segments? For instance, if an L2 learner of Korean fails to pronounce [tal] 'month' and instead produce [t'al] 'daughter' in utterance-initial position, would he/she also produce the same [t'al] as in the utterance-

initial position for *cinan* [dal][4] 'last month' ([d] across a word boundary)? If not, would he/she produce a different stop sound such as [tal]* or [dal], being aware of the prosodic/postlexical rule (i.e. the intervocalic voicing rule)?

Recently, Young-Scholten (1992, 1993, 1994, and 1997) investigated the acquisition of postlexical rules in adult L2 phonology. Young-Scholten's previous studies look at an allophonic phenomenon accompanying resyllabification which is constrained by a postlexical rule at the prosodic level. The relevant parts of her studies to this present study are summarised in the following sub-sections and will be discussed later with regard to the issue of prosodic phonological rule constrained by syntax.

2.3.1. Young-Scholten (1994)

In Young-Scholten (1994), the acquisition of flapping in American English by German speakers was investigated with regard to the prosodic hierarchy proposed by Nespor and Vogel (1982, 1986).

(2.10) The prosodic hierarchy (from Nespor and Vogel 1982, 1986)

Phonological utterance
|
Intonational phrase
|
Phonological phrase
|
Clitic group
|
Phonological word
|
Foot
|
Syllable

[4] As we will see, voiced stops (i.e. [b, d, g]) do not underlyingly exist in Korean. However, according to the intervocalic voicing rule, the word-initial stop of a noun following an adjective becomes voiced. See Section 3.2.2.2 for more details.

As we see in (2.11), resyllabification regarding flapping in American English takes place within the intonational phrase. That is, /t/ or /d/ becomes ambisyllabic and undergoes flapping within the intonational phrase as well as within all lower domains.

(2.11) From Young-Scholten (1994: 204)

a. [$_{w}$butter] [ɾ] (nonderived phonological word)

b. [$_{w}$fatter] [ɾ] (derived phonological word)

c. John [$_{cg}$met [ɾ] us] at the station. (clitic group)

d. John [$_{p}$met [ɾ] Ann]. (phonological phrase)

e. [$_{I}$We can sit [ɾ] on the floor]. (intonational phrase)

f. [$_{U}$Roger, alias the rat *[ɾ], eats only cheese.] (phonological utterance)

On the other hand, in German, the final devoicing (as in /dib/ → [dip] 'thief') applies word-internally to obstruents when they are not followed by a vowel. As in English, complete resyllabification does not occur in German, and syllable-final consonants may become ambisyllabic (e.g. /dib + ə/ → [dibə] 'thieves'). Such resyllabification is more restricted in German than in English, occurring only within the clitic group, and takes place only when one of the two adjacent words is a pronominal clitic and the other is its host (see Young-Scholten 1993 for more details) as shown in (2.12a).

(2.12) From Young-Scholten (1994: 205)

a. Das [$_{cg}$hab [b] ich gesehen. 'I've seen that.'

b. Ich [$_{p}$find *[d] ihn] nicht. 'I can't find him.'

c. Ich [$_{p}$hab *[b] Irene] gesehen. 'I've seen Irene.'

d. [$_{I}$Sie bestand *[d] einige Examen]. 'She passed some exams.'

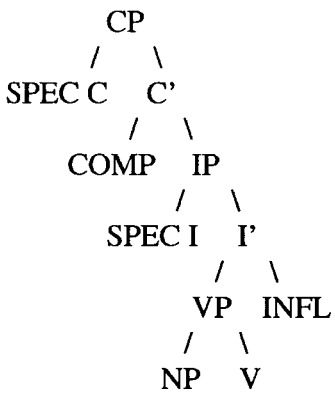
e. [$_{U}$Was ich getan hab *[b], erzähl ich dir nicht]. 'What I've done, I'm not telling you.'

Despite the differences between resyllabification of flapping in American English and that of final devoicing in German, the three German-speaking advanced learners of English flapped underlying /t/s and /d/s in domains of the phonological phrase and the intonational phrase where resyllabification is not permissible in German as well as in domains in which it is permissible in German. However, the learners flapped to a lesser degree across word boundaries than they did word-internally and less frequently within those domains in which resyllabification is not permissible in German. Under the Subset Principle[5], the study predicted that complete acquisition of both word-internal and word-external flapping would occur because the less restricted domain of resyllabification of English, a superset of the relevant domain in German, would be acquired by German learners.

2.3.2. Young-Scholten (1997)

Young-Scholten (1997) investigated the acquisition of pronominal cliticisation in German by American English-speaking learners. In the study, she adopted Kaisse's (1985) classification of postlexical rules. According to Kaisse, rules constrained by factors relating to surface structure syntax belong to the Pl level (e.g. French liaison and English "wanna" (*want to*) contraction) and purely phonological rules which apply exceptionalessly belong to the P2 level. Assuming the syntactic structure in (2.13) (cf. Grewendorf-Hamm-Sternefeld 1987), she viewed that pronominal clitics in German can attach to COMP, the head of the functional projection CP; in other words, to a syntactically specified position, not to morphologically identified hosts.

(2.13) The syntactic structure for German (from Young-Scholten 1997:194)



She made the contrast between English and German clitics, stating the host for the English pronominal clitics is either a verb or a preposition; that is, the pronominal clitic host in English is the head of a lexical projection. Based on the comparison, she

[5] According to the Subset Principle (Berwick 1985), the superset grammar is more general and generates all the sentences and forms that the more restrictive subset generates as well as additional sentences or forms. Young-Scholten (1994) adopted the principle to the adult L2 acquisition of phonology.

predicted that the L2 learners could transfer prepositional and verbal clitic hosts from English; however, the syntactic conditions on cliticisation would be impossible to acquire if they had not acquired the correct syntactic structure for German.

On the other hand, it was also predicted that the learners would experience no difficulties acquiring some other pronominal clitics in German belonging to the P2 level. For example, the English clitics *r* (for her) and *m* (for him and them) behave exactly like the *n* clitic (for ihn) in German and become the syllabic nucleus of a newly created syllable when the single consonant clitics attach to hosts. Thus, positive L1 transfer was predicted regarding the nasal clitics *n* and *m* owing to the near-identity. The acquisition of the clitics *s* and schwa was expected, too, as related to P2 rules and to the equally complex syllable structure of English and German and the presence of schwa in English clitics.

Nine American English- and ten German-speaking subjects were individually tested on a grammaticality judgement test and a sentence repetition test back-to-back. The non-native speakers had begun to acquire German after the age of thirteen, and most of them were students at a German university. At the time of testing, the mean age of non-native speaker group was 29.78 years old. In conclusion, as expected, the acquisition of clitics related to P2 rules appeared successful, seemingly as the result of L1 transfer. However, there was evidence that the syntactic conditions had not been learned. The learners treated cliticisation in German similarly to cliticisation in English by transferring their English P1 rules of simple cliticisation to German cliticisation. Yet, it was assumed that these learners might be still in process of acquiring cliticisation in German.

Going back to the example mentioned in the beginning of Section 2.3, would L2 learners of Korean whose L1 has only two types of stops be able to acquire the three types of stops (i.e. *plain*, *tense* and *aspirated*) in Korean? Would the word-initial segments in their interlanguage (whether they are correct or not) remain the same across word boundaries, or would they take a different form from the utterance-initial segments? In order to produce the target pronunciation across the word boundary such as [dal] in *cinan* /tal/ 'last month' and [t'al] in *ipen* /tal/ 'this month', the learners must acquire post-lexical phonological rules constrained by syntactic conditions. Getting the correct pronunciation of the stops in the word-initial position would not automatically guarantee to correctly produce the target pronunciation of the stops across the word boundary.

This thesis examines the L2 acquisition of Korean stops both in the word-initial position and across the word boundary, so as to show the complexity of phonological representations and rules involved in a segment, which might be the reason for the difficulty in attaining native-like L2 phonology. In order to deal with this issue, we first take a general overview of Korean phonology concerning the three types of Korean stops in the following chapter.

Chapter 3. General Overview of Korean vs. English and Finnish Stops

As we have seen, not only must the segments themselves be acquired for the target pronunciation in L2 phonology but also any prosodic/postlexical rules which apply to them. Therefore, here the three distinctive types of Korean stops are examined as independent segments and with regard to the Korean-specific tensification rule and the universally-distributed intervocalic voicing rule, both of which are constrained by syntactic conditions.

In this chapter, Korean stops are outlined in comparison with stops in English and Finnish, which are the L1s of the subjects of the present study. By considering the characteristics and two contrasting phonological rules (i.e. tensification vs. intervocalic voicing) of Korean stops, predictions for L2A of Korean stops will be suggested in consideration of following two questions.

- How does the content of L1 structures affect the acquisition of L2 segments?
- Why are prosodic/postlexical rules regarded more difficult for L2 learners to acquire?

3.1. VOT and Phonological Representations

Korean consonants are classified as shown in (3.1), according to the place (i.e. labial, dental, velar, palatal and glottal) and manner (i.e. stops, affricates, fricatives, nasals, liquid and glide) of articulation. Among these, there are nine stops /p, p^h, p', t, t^h,

t', k, k^h, k'/[6], three affricates /c, c^h, c'/, three fricatives /s, s', h/, three nasals /m, n, ŋ/, one liquid /l/ and two glides /y, w/. In addition, it is worth noting that the voiced obstruents (i.e. /b, d, g, j[7]/) do not appear in the Korean consonantal phonemic inventory, although they are produced as the result of the Intervocalic Voicing rule.

(3.1) Korean consonantal phonemic inventory (Ahn 2004: 28)

		Labial	Dental	Velar	Palatal	Glottal
Stops & Affricates	Plain	p	t	k	c	
	Aspirated	p^h	t^h	k^h	c^h	
	Tense	p'	t'	k'	c'	
Fricatives	Plain		s			h
	Tense		s'			
Nasals		m	n	ŋ		
Liquid			l			
Glides		ɟ				w

The three distinctive types of Korean stops are known as the Korean stop triplets: the plain stops /p, t, k/, the aspirated stops /p^h, t^h, k^h/ and the tense stops /p', t', k'/. The segments in these three groups of Korean stops are distinctive phonemes. Accordingly, the alternation of these stops confers a different meaning, as shown in (3.2).

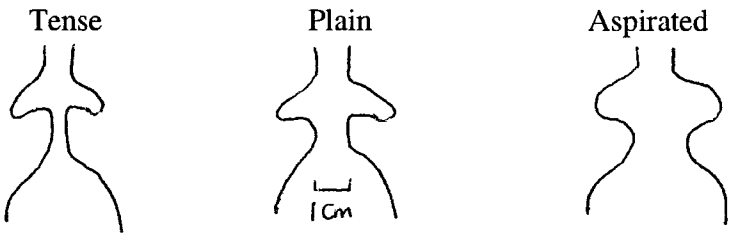
(3.2) Minimal pairs

a.	**p**ang 'room'	b. **t**al 'moon'	c. **k**i 'energy/spirit'
	p'ang 'bread'	**t'**al 'daughter'	**k'**i 'talent'
	p^hang 'bang'	**t^h**al 'mask'	**k^h**i 'height'

[6] The apostrophes marked in /p', t', k'/ indicate the sounds of tense obstruents in this study.

The stops and affricates are classified into *plain*, *aspirated* and *tense*. The plain are also called *lax* or *lenis*, and the tense *reinforced* or *fortis*. It has been observed that native Korean speakers categorically perceive the distinction of these stops by relying on the degree of aspiration and tenseness (Dart 1987; Han and Weizman 1965, 1970; Kim 1970). Ahn (2000: 3) remarks that tense stops are unaspirated, plain stops slightly aspirated and aspirated stops heavily aspirated. When aspirated sounds are produced, the vocal cords remain wide open after the release of the plosive and into the initial articulation of the following vowel. According to C-W Kim (1970: 110), a vocal fold shape for each type of Korean stop appears at the time of release as follows:

(3.3) Vocal fold shapes for Korean stops



As for tenseness, Korean *reinforced* or *fortis* stops are described by using the term 'tension'. (Han and Weitzman 1965 and Martin 1974). Han and Weitzman remark that Korean tense stops are produced with a "great deal of pressure at the closure which is naturally accompanied by glottal tension" (1965:5). Martin elaborates the description of Korean tense stops as below:

> "The tense consonants are pronounced with great muscular tension, both locally and through the entire vocal tract. The laryngeal tension continues into the following vowel (which can be said to be "laryngealized", i.e.

[7] [j] is produced as the allophone of /c/ in the equivalent way that the voiced stops [b, d, g] are produced by the Intervocalic Voicing rule.

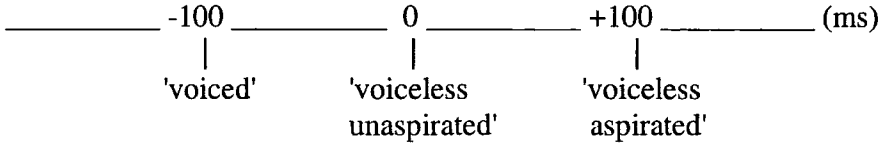
somewhat gargled) and the effect is a clearcut "popping" release similar to that of glottalized consonants, but with no separately heard glottal release. The tense consonants are never voiced, and they occur only syllable-initial." (Martin 1974: 39)

Firstly, the voice onset time (VOT) values of stops (which are acoustic measurements) are provided in order to see the acoustic differences between the stops. Then, phonological representations of the stop phonemes in the three languages under consideration are compared with each other.

3.1.1. Voice Onset Time

Voice Onset Time (VOT)[9] is more commonly adopted to acoustically distinguish the three types of Korean stops. The standard measurement of voicing and voicelessness in stops is VOT, originally proposed in Lisker and Abramson (1964). The VOT continuum includes *voiceless aspirated*, *voiceless unaspirated* and *voiced* stops arranged along a scale relating the time of release of the articulators to the onset time of regular vocal-cord vibration. To illustrate the spread of different types of stops on the continuum, the standard is to set zero as the time of consonant release. Voicing that begins before the release of the articulators is assigned a negative value whereas voicing that is delayed beyond release is assigned a positive value.

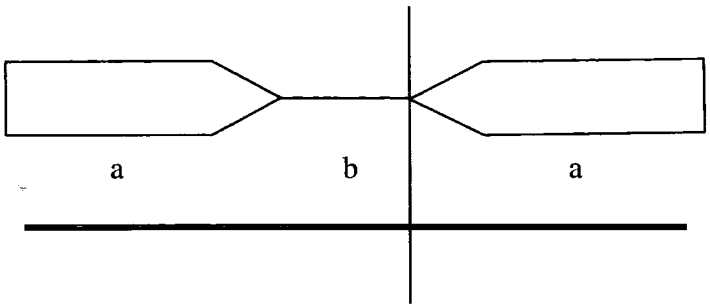
(3.4) The VOT Continuum (from Nathan 1987: 314)



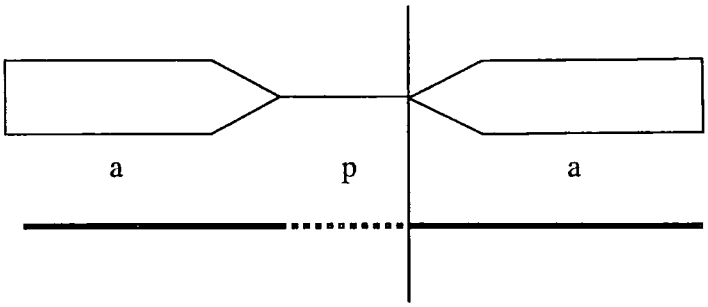
[9] Although the present study does not acoustically measure VOT values, I mention them as one of ways to help understanding differences among the three distinctive types of Korean stops.

This acoustic distinction associated with stops can be visually demonstrated on schematic diagrams as demonstrated in (3.5).

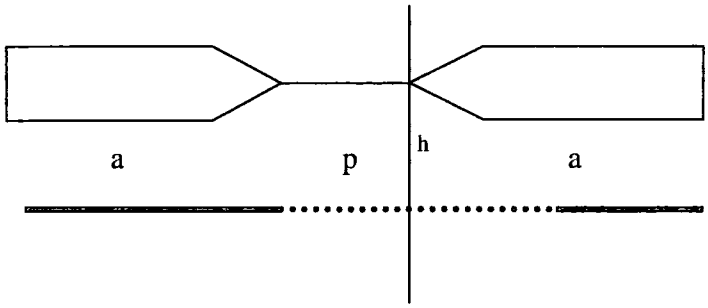
(3.5) a. Fully voiced stop (from Davenport and Hannahs 1998: 70)



b. Voiceless unaspirated stop



c. Voiceless aspirated stop



In (3.5a-b), voicing is indicated by a thick black line and lack of voicing by a broken line. The articulators are shown as closed by a straight line above the stop consonants and as open by parallel lines above the vowel /a/. A vertical line indicates the point at which the articulators open. Thus, with a fully voiced stop in (3.5a) voicing continues from the first vowel /a/ through the closure and release of the /b/ and into the second vowel /a/. If there is a significant delay between the stop release and the subsequent onset of voicing, that is, if the stop is released before voicing starts, aspiration (i.e. a little puff of air accompanying the release of certain stops) occurs as in (3.5b) and (3.5c). In fact, it is the result of the timing sequence of stop release and voicing. In short, VOT is the moment at which the voicing starts relative to the release of closure.

In order to define the distinction among labial, dental and velar stops, VOT has been investigated in many studies (e.g. Lisker & Abramson 1964; Han & Weitzman 1970; Silva 1992; M-R Kim 1994; Han 1996; Cho 1996). VOT is one of the most important (but not absolute) cues that differentiate the plain, the tense and the aspirated stops in Korean from one another. VOT is shortest for the tense stop, intermediate for the plain stop and longest for the aspirated stop. As we see in (3.6), the VOT values appear between 7-20ms (Mean=13) for the tense stops, between 51-71ms (Mean=61) for the plain stops and between 89-125ms (Mean=105) for the aspirated stops.

(3.6) Voice Onset Time in the word-initial (ms) (from Silva: 1992)

	Labial	Initial	Dental	Initial	Velar	Initial	Mean
Plain (Silva 1991)	p	60	t	51	k	71	61
Tense (Han & Weitzman 1970)	p'	7	t'	11	k'	20	13
Aspirated (Han & Weitzman 1970)	p^h	89	t^h	100	k^h	125	105

The aspiration degrees of English, Finnish and Korean stops may be visualised on the continuum as in (3.7) in order that the relation between VOT and the acquisition of stops can be discussed later. According to (3.7), among voiceless stops of the three languages (i.e. English, Finnish and Korean), Korean tense stops are the least aspirated and Korean aspirated stops the most aspirated.

(3.7) The degree of aspiration and VOT values of Korean, English and Finnish stops (Silva 1992 and Suomi 1980)

	voiceless			voiced		
less aspirated ↓ more aspirated	labial	dental	velar	labial	dental	velar
	Korean tense stops			Korean		
	7	11	20	8	10	17
	Finnish stops			Appear only word-medially		
	9	11	20			
	Korean plain stops			English		
	22	30	48	1	5	21
	English stops			Finnish		
	58	70	80	--	--	--
	Korean aspirated			fully voiced		
	89	100	125			

3.1.1.1. Comparison with Other Languages

By comparing the Korean labial stops with those in other languages, it may be better captured how Korean stops are different from each other. The table in (3.8) shows that the Korean labial stops are all voiceless distinguished by the degree of aspiration and tenseness, whereas English, French and Thai differentiate labial stops by means of voicing and/or aspiration. Dental stops /t, t^h, t'/ and velar stops /k, k^h, k'/ in Korean are also distinguished from one another in the same manner.

(3.8) Labial stops in Korean and other languages (Ladefoged 1982:132)

	Korean	English	French	Thai
Full voicing			b	b
Partial voicing		b		
Voiceless unaspirated		(s)p	p	p
Voiceless (tense) unaspirated	p'			
Voiceless slightly aspirated	p	p		
Voiceless heavily aspirated	p^h			p^h

Although Finnish is not presented in (3.8), Finnish stops may be considered almost identical to French stops because Finnish voiced stops are fully voiced according to Suomi (1980). However, this may not be true in the word-initial position, where Finnish voiced stops hardly appear in native Finnish words. In fact, it is known that there are no native Finnish words beginning with a voiced stop. (Leney 1999, Vähämäki 2000)

3.1.2. Phonological Representations

English, Finnish and Korean exploit distinctive features in different ways to distinguish stops within each of the three languages. Stop sounds from phoneme inventories of the three languages are illustrated in the following subsections. Looking at them one by one, I will focus on the laryngeal (L) node of each stop, but the supra laryngeal (SL) nodes of the stops are not elaborated on here and are illustrated only with its sub-node 'Place' alone, as the supralaryngeal node is not the concern of this study.

3.1.2.1. Phonological Representation for Korean Stops

In order to distinguish the plain, the tense and the aspirated from each other, Ahn (1998) adopts the feature representation shown in (3.9).

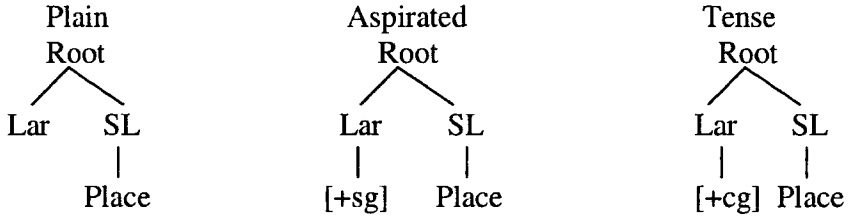
(3.9) Tense : [+tense, -aspirated]

Plain : [-tense, -aspirated]

Aspirated : [-tense, +aspirated]

Here, the feature [+aspirated] is used as the crucial feature for the heavily aspirated stops /p^h, t^h, k^h/, whilst the feature [+tense] is the major one for the unaspirated stops. The plain stops are not specified for either of the features, based on underspecification (see e.g. Archangeli 1984, Kiparsky 1982). In other words, they are underlyingly unmarked for the features of [aspirated] and [tense], and are filled in by default rules in the later stage of derivation. Both underspecification theory and feature geometry have been exploited to motivate an analysis of Korean stops based on laryngeal features. K-H Kim (1987) proposes that in underlying representation, aspirated consonants are specified with the feature [+spread glottis], tense consonants are specified with the feature [+constricted glottis] and plain consonants have no laryngeal features.

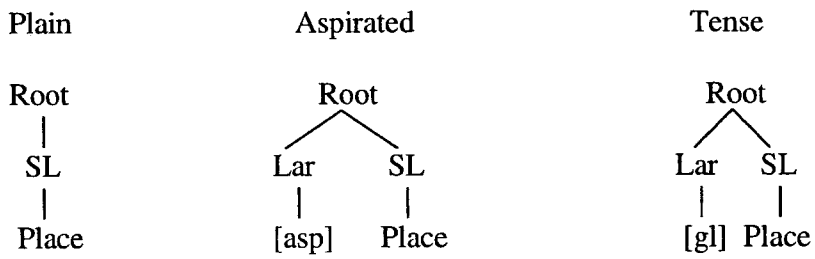
(3.10) Underlying Phonological Structure of Korean Stops after K-H Kim (1987)



*Glossary - Lar: laryngeal, SL: supra laryngeal, sg: spread glottis, cg: constricted glottis

On the other hand, Lombardi (1991) claims that Korean has three universal laryngeal features: [aspirated], [glottis] and [voice] and that the relevant feature for making the appropriate underlying distinctions are [aspirated] and [glottis]. Lombardi's use of [aspirated] and [glottis] is analogous to K-H Kim's use of [+sg] and [+cg]. However, unlike K-H Kim (1987), she does not specify a laryngeal node for plain obstruents, arguing that "there is no phonological contrast between a representation with a bare laryngeal node and no laryngeal node at all" (1991: note 4).

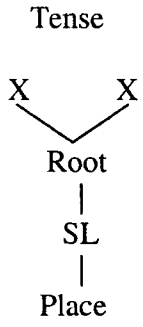
(3.11) Underlying Phonological Structure of Korean Stops after Lombardi (1991)



*Glossary - Lar: laryngeal, SL: supra laryngeal, asp: aspirated, gl: glottis

In contrast to the analyses of K-H Kim (1987) and Lombardi (1991), Ahn and Iverson (2001, 2003), S-H Kim (1990) and Han (1992) assign tense segments two timing slots on the timing tier without a Laryngeal node, arguing that the tense stops are plain geminates.

(3.12) Underlying Phonological Structure of Korean Tense Stops
based on S-H Kim (1990) and Han (1992)



Silva (1992) also supports S-H Kim's (1990) and Han's (1992) underlying representations for the Korean tense stops, claiming that "one advantage to an analysis that calls for underlying geminates is that it captures the observed differences in stop closure duration found for reinforced stops" (p.59). S-H Kim (1990) and Han (1992) argue that Korean tense stops are 'geminate plain consonants'. Specifically, Han noted that the Korean plain and tense consonants are distinguished by both structural and featural specifications. Moreover, Ahn and Iverson (2004) [10] claims that Korean has the laryngeal feature [sg] for aspirated stops and tense stops are the geminates of plain stops. Ahn and Iverson (2004) considers that Korean utilises duration of a segment as a primary, not secondary, cue in differentiating tense consonants, i.e., geminates, from the rest of the stops. (p.354) Moreover, they argue that the Korean tense consonants as geminates freely occur in word-initial position.

To sum up, Korean stops are classified in three ways called *Aspirated, Plain* and *Tense*. None of them are voiced; Korean does not have voiced stops at the underlying level. The laryngeal node of plain stops is bare, the feature [spread glottis] ([sg]) is

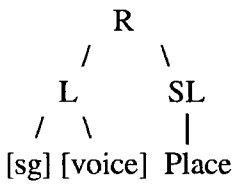
[10] The present study follows Ahn and Iverson's claim in principle. However, it is still under debate how to make distinctions in the three types of Korean stops.

marked to be pronounced as [p^h, t^h, k^h], the heavily aspirated stops (Steriade 1991; Silva 1992; Ahn and Iverson 2001, 2003). The feature [sg] plays the key role for the distinction between aspirated stops and plain stops, both of which are single-timing slotted.

(3.13) Korean stops from the Korean phonemic inventory (Ahn 1996: 37)

	Bilabial			Alveolar			Velar		
Stop	p^h	p	p'	t^h	t	t'	k^h	k	k'

(3.14) Korean laryngeal node

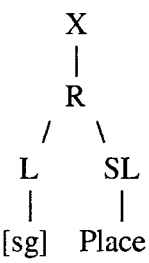


However, tense stops, having two-timing slots, are distinguished from the other two types of Korean stops at the timing tier as well as by the distinctive feature [sg].

(3.15) Three-way distinction of Korean stops

a. /p, t, k/

b. /p^h, t^h, k^h/



c. /p', t', k'/

The double-timing slots of the tense stops are preserved in the word-initial position as geminate CC as well as in the word-medial position (Ahn and Iverson 2004: 355-356). This concept may look contradictory to the generalisation that Korean tolerates at most one consonant in the onset since the syllable structure of Korean is known as (C)(G)V(C) (suggested by K-O. Kim and Shibatani 1976). Ahn and Iverson (2004) argues, however, that nothing special needs be said beyond the general constraint on Korean syllable structure given in (3.16), which prohibits syllable-internal clusters of singleton consonants.

(3.16) Korean Cluster Constraint (Syllable-internal)
(copied from Ahn and Iverson 2004: 356)

According to them, "this constraint precludes clustering of consonants whose association with phonological features is independent of one another, but it does not block CC arrangements which share phonological feature structure. This is because the familiar Autosegmental Linking Condition ("lines of association are interpreted as exhaustive", Hayes 1986) limits the domain of statements like (3.16) to configurations which meet its structural description exactly. As lines of association in (true) geminates do not match up precisely with those in (3.16), structures of the kind in (3.17) standing for Korean tense consonants are sanctioned in onsets in the same way as are singleton consonants." (p. 356)

(3.17) Geminates Permitted (copied from Ahn and Iverson 2004: 356)

```
C  C
\  /
 [ ]
```

3.1.2.2. Phonological Representations for English Stops

There are two way distinctions, voiced /b, d, g/ and voiceless /p, t, k/ in English stops, of which minimal pairs are illustrated in (3.18).

(3.18) Minimal pairs of English stops

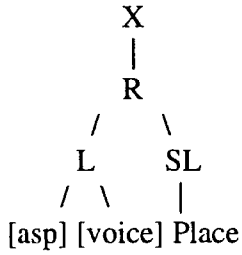
a. pig	b. tale	c. kill
big	dale	gill

In English, the feature [aspirated] (henceforth, [asp]) on the laryngeal node enables English speakers to distinguish voiceless stops from voiced ones. Both types of the English stops are single-timing slotted.

(3.19) English stops from the English phoneme inventory (Ladefoged 1982: 33)

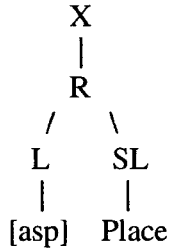
	Bilabial		Alveolar		Velar	
Stop	p	b	t	d	k	g

(3.20) English laryngeal node



(3.21) Distinction between voiceless and voiced stops in English

a. /p, t, k/



b. /b, d, g/

3.1.2.3. Phonological Representations for Finnish Stops

There are also two way distinctions, voiced /b, d, g/ and voiceless /p, t, k/ in Finnish stops. However, it is only the set of unaspirated voiceless stops, /p, t, k/ that Finnish allows in word-initial position. It is in loan-words where voiced stops word-initially appear in Finnish (Leney 1999: 13). Even though Häkkinen (1996: 93) includes voiced stops /b, d, g/ in the Finnish phoneme inventory, it is in question whether the word-initial voiced stops (e.g. /b/ and /g/ in *bussi* 'bus' and *grilli* 'grill') are pronounced the same as voiced stops in English or more like Finnish unaspirated voiceless stops.[11]

(3.22) A minimal pair of Finnish stops

pussi 'bag'

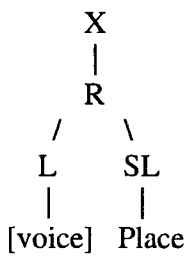
bussi 'bus'

In Finnish, it is the feature [voice] on the laryngeal node that enables Finnish speakers to discern voiced stops from voiceless ones. This is because /p, t, k/ are not aspirated, unlike in English (Vähämäki 2000: xii; Leney 1999: 10). Furthermore, these Finnish stops are always single-timing slotted in word-initial position. It should be also noted that in Finnish, geminates appear only in the word-medial position as double consonants of an unaspirated voiceless stop.

(3.23) Finnish stops from the Finnish phoneme inventory (Häkkinen 1996: 93)

	Bilabial		Alveolar		Velar	
Stop	p	b	t	d	k	g

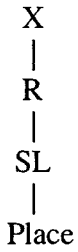
(3.24) Finnish laryngeal node



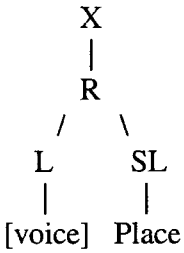
[11] This issue need not be considered in this study because it is the feature [sg] on the laryngeal node that differentiates Korean stops in initial position of word in any case. The feature [voice] does not utterance-initially appear in Korean.

(3.25) Distinction between voiceless and voiced stops in Finnish

a. /p, t, k/



b. /b, d, g/



To summarise, (3.26), (3.27) and (3.28) illustrate the distinctive features and timing units of the stops in the phoneme inventories of English, Finnish and Korean.

(3.26) English stops

	Bilabial		Alveolar		Velar	
Timing unit	X	X	X	X	X	X
Distinctive feature	[asp]	--	[asp]	--	[asp]	--
Stops	p	b	t	d	k	g

(3.27) Finnish stops

	Bilabial		Alveolar		Velar	
Timing unit	X	X	X	X	X	X
Distinctive feature	--	[voice]	--	[voice]	--	[voice]
Stop	p	b	t	d	k	g

(3.28) Korean stops

	Bilabial			Alveolar			Velar		
Timing unit	X	X	XX	X	X	XX	X	X	XX
Distinctive feature	[sg]	--	--	[sg]	--	--	[sg]	--	--
Stop	p^h	p	p'	t^h	t	t'	k^h	k	k'

3.2. Allophonic Variation of Plain Stops

Now we examine the distribution of the Korean stops. Among the three types (i.e. *plain*, *aspirated* and *tense*) of Korean stops, only plain stops change in a certain environment. There are three allophonic variants for Korean plain stops: *tensification*, *intervocalic voicing* and *aspiration*. Whereas voicing and aspiration are purely constrained by a phonological environment, tensification is influenced by other grammatical factors as well (Selkirk 1982, Kaisse & Shaw 1985, and Vogel & Kenesei 1990). By intervocalic voicing, the plain stops /p, t, k/ change to [b, d, g] when between voiced segments, and aspiration occurs when plain stops are adjacent to */h/*.

3.2.1. Tensification (Plain to Tense)

Tensification in Korean is caused by various factors. We will look at five types of tensification in this section.

3.2.1.1. Post-Obstruent Tensing (POT)

The Post-Obstruent Tensing (POT) rule applies where plain consonants are followed by obstruents. This type of tensification is purely phonological and is not influenced from other grammatical components. The rule of POT provided in Ahn (1998) is shown in (3.30).

(3.29) Examples

hak + /p/o	→ hak[p']o	'university newspaper'
us + /t/a	→ ut[t']a	'to smile'
ak + /k/i	→ ak[k']i	'musical instrument'

(3.30) Post-Obstruent Tensing

$$\begin{bmatrix} -son \\ -asp \end{bmatrix} \rightarrow [+tense] / [-son] \_\_\_\_\_$$

Under POT in (3.30), the plain stops /p, t, k/ in the post-obstruent position in (3.29) become the tense stops [p', t', k'], respectively.

Whereas POT is purely constrained by the phonological environment, the other types of tensification are constrained by syntax and semantics (e.g. Modifier Tensification observed by Chung 1980), too. Ahn (1985) classifies the Korean tensification into five types; 'Noun + Noun' Compounding I (*t*-epenthesis), 'Noun + Noun' Compounding II (*n*-epenthesis), 'Predicate stem + Ending', 'Determiner (or Modifier, derived from verb/adjective) + Noun' and Sino-Korean. Among these five types of tensification, 'Noun + Noun' Compounding I (*t*-epenthesis), 'Noun + Noun'

Compounding II (*n*-epenthesis) and 'Determiner (or Modifier, derived from verb/adjective) + Noun' occurs across word or morpheme boundaries; 'Predicate stem + Ending' across inflection boundaries; and Sino-Korean within a word. The summary of these five types of tensification based on Ahn (1996: 97-98) is as following:

3.2.1.2. Compound Tensification (C-epenthesis)

There are two types of noun compound tensification in Korean. One is the result of *t*-epenthesis, and the other by *n*-epenthesis. Depending on the phonological environment, the type of epenthesis varies.

i. Compound Tensification I (*t*-epenthesis)

This type of tensification occurs in the second word-initial position of a 'noun + noun' compound and is caused by *t*-epenthesis. This *t*-epenthesis between the two compounding nouns then triggers POT, which changes plain stops to tense stops, as shown in (3.31).

(3.31) Examples

cam	/c/ali	cam[**c'**]ari	'sleeping place'
sleep	place		
nay	/k/a	nay[**k'**]a	'rive side'
river	side		

The process of tensification led by *t*-epenthesis is illustrated below, and the rule formulated by Ahn (2000) is presented in (3.33).

(3.32) Process of tensification

cam+/c/ali	nay+/k/a	underlying
'sleep' 'place'	'river' 'side'	
[[cam]t[cali]]	[[nay]t[ka]]	t-epenthesis
[camtc'ari]	[naytk'a]	POT
[camc'ari]	-----	CC-cluster simplication
[camc'ari]	[nay(t)k'a]	phonetic representation

(3.33) *t*-epenthesis (domain: compounding)

Ø --> t / $]_N$ _____ $_N$[C

ii. Compound Tensification (*n*-epenthesis)

However, there are compound nouns to which *t*-epenthesis does not apply. For examples, /hopak yəs/ 'pumpkin candy' in (3.34) is derived to [hobaknyət] rather than [hobaktyət]. This is because the second word-initial segment of the compound word is the glide /*y*/ and the first word of the compound noun ends in a non-nasal segment. This phenomenon is known as *n*-epenthesis because [n] is realised between the two compounded nouns in the phonetic representation.

(3.34)	/hopak	yəs/	[hobaŋ[12]nyət]	'pumpkin candy'
	pumpkin	candy		
	/mikuk	yənghwa/	[miguŋnyənhwa]	'American movie'
	American	film		

Ahn (2000) provides the rule of n-epenthesis as below.

(3.35) *n*-epenthesis

$$\emptyset \rightarrow n \;/\; C\,]_N \_\_\_\_\_ N[\; y$$

3.2.1.3. Predicate Tensification

This type of tensification occurs in verbs. It takes place when a verb stem is conjugated with an inflectional, nominalising or negation suffix as illustrated in (3.36).

(3.36) Examples

sum-/t/a	sum-[t']a	'hide'	Dictionary form
sum-/k/i	sum-[k']i	'hiding'	Nominalisation
sum-/c/ima	sum-[c']ima	'Don't hide'	Negation

In the examples in (3.36), /t, k, c/ in the inflectional suffix are tensified and become [t', k', c'] respectively after the verb stem *sum*. This rule applies only to the suffixes which follow a stem ending with a nasal. The rule of Predicate Tensification, which Ahn (1985) proposes, is shown in (3.37).

(3.37) Predicate Tensification (Domain: Inflection, Noun-derivation, (Passive))

$$[\text{-son}] \rightarrow [\text{+tense}] \;/\; [\text{+nasal}]]_{V/A} \_\_\_\_\_$$

[12] In Korean, /k/ before [+nasal] becomes [ŋ] due to assimilation. Here, inserted /n/ triggers nasalisation of /k/.

3.2.1.4. Modifier Tensification

Among modifiers with [+son] in word-final position, it is the modifying suffix *-(u)l* that triggers Predicate Tensification, while others tend to cause voicing. It takes place when the modifying suffix *-(u)l* precedes plain obstruents.

(3.38) Examples

mek-ul	/p/ap	megul [p']ap	'rice to eat'
eat -MOD	rice		
cwu -l	/t/on	cwul [t']on	'money to give'
give -MOD	money		

In the examples in (3.38), [p, t] following *-(u)l* are tensified and become [p', t'], respectively. Ahn (1985) regarded this phenomenon as postlexical and formulated the rule as in (3.39).

(3.39) Modifier Tensification

$$[-son] \rightarrow [+tense] / [+lateral]_D \_\_\_\_$$

3.2.1.5. Sino-Korean Tensification

Some Sino-Korean words apply the generalisation that the coronal obstruents [t, c, s] are tensified after [l] and become [t', c', s'] as we see in (3.40).

(3.40) Examples

pal /t/al	pal[t']al	'development'
tol /c/in	tol[c']in	'rush'
il /s/wun	il[s']wun	'one moment'

The rule for Sino-Korean Tensification proposed in Ahn (1985) is shown below:

(3.41) Sino-Korean Tensification

$$\left\{ \begin{array}{c} t \\ c \\ s \end{array} \right\} \rightarrow [+\text{tense}] / l \_\_\_\_\_$$

Ahn (2000) added that Sino-Korean Tensification in (3.41) is a phonological rule motivated by a phonetic efficiency, in terms of the 'directionality of articulation'. Therefore, it is not related to the C-epenthesis rule.

As summarised above, tensification in Korean is not purely phonologically constrained but related to other grammatical components of the language as well. To acquire the target pronunciation, it is required to have the subtle knowledge how the phonology of the language interacts with other grammatical components. As I quoted earlier, Young-Scholten (1993: 3-4) mentioned that prosodic factors might conspire to result in incomplete acquisition and that L2 learners are likely not to acquire the post-lexical application of phonological rules. Thus, I assume that L2 learners of Korean would find it more difficult to acquire the tensification rules requiring the knowledge of prosodic/postlexical rules (in terms of when intervocalic voicing is blocked for tensification) than those which are constrained purely by phonological rules.

3.2.2. Intervocalic Voicing (or Weakening)

In Korean, voicing of plain stops occurs intervocalically. Intervocalic voicing within and beyond the word is outlined below.

3.2.2.1. Within Words

Voiced stops always appear only word-medially where both of the neighbouring sounds are voiced. Since plain stops and voiced stops in Korean are in complementary distribution, voiced stops are to be analysed as an allophone of the same phoneme of a plain stop (Han and Weitzman 1965: 4). Ahn (1996: 25-31) stated that the voiced stops [b, d, g] are derived intervocalically (or between a sonorant segment and a vowel) from the voiceless plain stops /p, t, k/, which remain as [p, t, k] syllable-initially as well as syllable-finally. However, aspirated and tense stops do not have such allophonic variations in Korean as we see in (3.42).

(3.42) Examples

a. pa + /t/a	→	pa[d]a	'sea'
tae + /k/i + sil	→	tae[g]isil	'waiting room'
a + /p/e + ci	→	a[b]eci	'father'
b. ci/p^{h}/ulaki	→	ci[p^{h}]ulaki	'hay'
to/t^{h}/oli	→	to[t^{h}]oli	'hazel nut'
so/k^{h}/wuli	→	so[k^{h}]wuli	'bamboo basket'
c. ppo/p'/o	→	ppo[p']o	'kiss'
mey/t'/wuki	→	me[t']wuki	'grasshopper'
ca/k'/wu	→	ca[k']wu	'over and over again'

In (3.42a), intervocalic plain stops become voiced whereas aspirated stops in (3.42b) and the tense stops (3.42c) do not undergo any phonological transformation. The allophonic variation of plain stops is formulated as in (3.43) according to Ahn (1985).

(3.43) Intervocalic Voicing

$$\begin{bmatrix} \text{-voice} \\ \text{-asp} \\ \text{-tense} \end{bmatrix} \rightarrow \begin{bmatrix} \text{+voice} \\ \text{-asp} \\ \text{-tense} \end{bmatrix} / \text{[+son]} \_\_\_\_ \text{V}$$

Silva (1992) illustrated the intervocalic voicing degree of Korean stops by means of VOT. The table in (3.44) demonstrates that the VOT values of plain stops /p, t, k/ ranging from 51 to 71 in word-initial position dramatically decrease to 8 to 17 in word-medial position. On the other hand, aspirated stops remain as the identical type of stops (i.e. aspirated stops but not plain stops) although they are acoustically weakened in the word-medial position by decreasing the VOT. The VOT values of tense stops between word-initial position and word-medial position are minimal, showing only 1-2ms differences.

(3.44) Voice Onset Time in the word-initial and word-medial positions (from Silva: 1992)

	Labial	Initial	Medial	Dental	Initial	Medial	Velar	Initial	Medial
Plain	p	60	8	t	51	10	k	71	17
Tense	p'	7	5	t'	11	12	k'	20	21
Aspirated	p^h	89	75	t^h	100	78	k^h	125	93

This voicing phenomenon of Korean plain stops can be compared with the VOT values of Korean plain stops with those of English stops because English stops are distinguished by the feature [±voice] and classified into two different types of phonemes. The VOT values in (3.45) show that word-medial Korean plain stops are closer to English voiced stops /b, d, g/ and that word-initial Korean plain stops are closer to English voiceless stops /p, t, k/.

(3.45) Voice Onset Time of English stops (from Silva: 1992)

	Labial	Initial	Medial	Dental	Initial	Medial	Velar	Initial	Medial
Voiced	b		1	d		5	g		21
Voiceless	p	58		t	70		k	80	

3.2.2.2 Beyond the word

The allophonic phenomenon resulting from intervocalic voicing occurs not only at the word level but also beyond it in Korean. To investigate this, a number of recent studies have attempted to show that VOT varies as a function of prosodic position (e.g. Silva 1992; Jun 1993, 1995; Cho 1998; Cho & Keating 1999). Jun (1993) has found that VOT is accumulative in accordance with prosodic factors. In her study, the VOT of /p^h/ was systematically longer at the beginning of a word than medially in a word, and longer at the beginning of a small phrase, the Korean Accentual Phrase. In other words, while Korean aspirated stops remain aspirated, the degree of aspiration is prosodically constrained. Likewise, the VOT values of Korean plain stops are observed to vary according to prosodic position. However, unlike aspirated stops, plain stops with

decreased VOT values in the intervocalic position are described as 'voiced'. Silva (1992: 75-78) called this VOT variation of plain stops Lenis Stop Voicing (LSV) and provided some basic data on LSV. He looked at a number of works, primarily Y.-M. Y. Cho (1987, 1990), Silva (1989, 1991), Jun (1991) and Kang (1991) and emphasised that Lenis Stop Voicing is obligatory within words and highly favoured (but still optional) in the cases presented below. Examples of plain stop voicing illustrated in (3.46) are taken from Silva (1992) except for (3.46b) and (3.46d). In Silva's data, he used '_' for a word boundary within a constituent and '/' where external voicing sandhi is blocked.

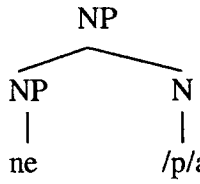
(3.46) Basic Data on Lenis Stop Voicing

a. Within a word (obligatory)

b. Between a determiner and a noun

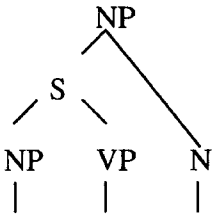
c. Between an adjective (adnominal) and a noun

d. Between a possessive and a noun



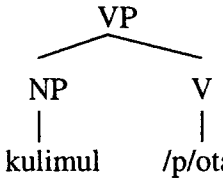
'your trousers'

e. Between the verb of a relative clause and the head noun



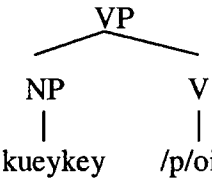
'the rice that he eats'

f. Between an object and a verb



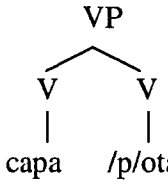
'to look at a picture'

f'.



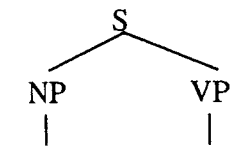
'to be shown to him'

g. Between two conjoined verbs



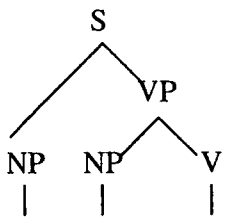
'to give it a try to hold'

h. Between a subject and a verb



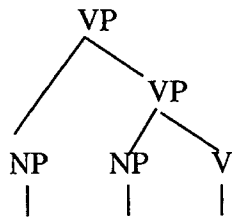
kayka canta → kayka / [c]anta 'the dog sleeps'

i. Between a subject and an object



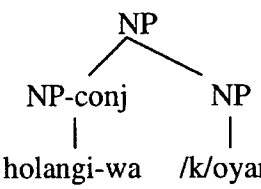
kayka /p/apul meknunta → kayka / [b]apul meknunta 'the dog eats (rice)'

j. Between two objects



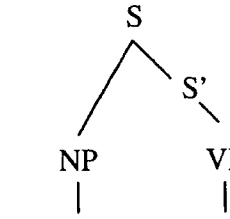
aieykey /k/wacal cunta → aieygey / [g]wacal_cunta '(e) gives the child candy'

k. Between conjoined noun phrases



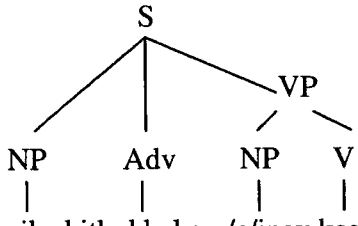
holangi-wa /k/oyangi → holangiwa / [g]oyangi 'tiger and cat'

l. Between a topic NP and the following sentence



sakwanun /p/elinta → sagwanun / [b]elinta '(e) throws apples away'

m. Between a sentential adverb and its neighbours



sunika kithukhakey /c/ipey kassta → sunika / kithukhakey / [j]ipey kassta
'It was good that Suni went'

Silva (1992) provided the following generalisation, given the type of data presented above.

(3.47) Voicing is a postlexical rule that generally applies when its environment ([+voice]_[+voice]) occurs wholly within a certain constituent but does not apply across the boundaries of that constituent. (Silva 1992: 78)

The main concern of this study is to investigate the acquisition of the two contrasting phenomena of tensification vs. intervocalic voicing in the syntactic form of an NP constituent; therefore, the prosodic structure of the voicing types given in (3.46b-d)

will be focused on regarding resyllabification in comparison with tensification in Section 3.3.

3.2.3. Aspiration (Plain to Aspirated)

Aspiration in Korean is solely constrained by the phonological environment but not affected by other grammatical factors. Choi (1937) and Huh (1968) stated that plain stops become aspirated by being adjacent to *h*.

(3.48) Examples

a. ca/p/ + hi → ca[p^h]i 'to be held'
'hold' PASS

pu/k/ # han → pu[k^h]an 'North Korea'
'north' ' Korea'

b. manh + /t/a → man[t^h]a 'much'
'much' DEC

coh + /c/i → co[c^h]i 'Good!'
'good' DEC

*Glossary: PASS – passive suffix, DEC – declarative ending marker

B-G Lee (1977) formulated this aspiration process as the Mirror Image rule in (3.49).

(3.49) Aspiration (Mirror Image)

$$\begin{bmatrix} +\text{obstr} \\ -\text{cont} \end{bmatrix}, [\text{-segment}] , \text{h} \quad \rightarrow \quad \begin{matrix} 1 & 2 & 3 \\ & [\text{+asp}] & \emptyset \end{matrix}$$
$$\quad 1 \qquad\quad 2 \qquad 3$$

Owing to the Aspiration rule (3.49), the plain obstruents [p, t, k, c] adjacent to [h] in (3.48) are aspirated and become [p^h, t^h, k^h, c^h], respectively. The rule is applied either from left to right or from right to left, and Ahn (2000) stated that the syllable-final segment is associated to the next onset when a syllable-final obstruent meets a syllable-initial *h* sequence or the reverse sequence occurs.

3.3. Focusing on Tensification vs. Intervocalic Voicing

This section concentrates on the comparison of the Korean-specific tensification rule and the intervocalic voicing rule in order to help comprehend better the plausible difficulty of acquiring the two contradictory prosodic/postlexical rules in L2A of Korean.

3.3.1. With Regard to Resyllabification

3.3.1.2. Tensification

Korean allows geminates in the word-initial and word-medial position at the underlying level as illustrated in (3.50) although not in the word-final position.

(3.50) Geminates in Korean

a. Word-initial geminates in Korean (Underlying forms)

words	ppwul 'horn'	ttal 'daughter'	kki 'talent'
output	[p'ul]	[t'al]	[k'i]
timing tier	X X X X \ / | |	X X X X \ / | |	X X X \ / |
segmental tier	p' u l	t' a l	k' i

b. Word-internal geminates in Korean (Underlying forms)

words	appa 'daddy'	itta 'later'	akka 'before'
output	[ap'a]	[it'a]	[ak'a]
timing tier	X X X X | \ / |	X X X X | \ / |	X X X X | \ / |
segmental tier	a p' a	i t' a	a k' a

Beyond the underlying level, tensification results from gemination of a plain stop in Korean. Gemination can be triggered in intervocalic position both within words (or word-internally) and across word boundaries (or word-externally) by undergoing the tensification rule (POT) in Korean. In Ahn (1998), such tensification is represented as C-epenthesis, with the provision that the initial consonant of the next syllable becomes tensed after a sonorant-final syllable, as tensification (or gemination) of /k/ in *chikwa*[13] 'dental clinic' is illustrated in (3.51).

[13] Ahn (1998) uses this Sino-Korean word as an example to illustrate the application of the sub-compounding tensification rule. However, I take the illustration as an example for word-internal gemination, based upon the fact that non-compound (Sino-Korean) words such as *coken* 'condition', *paltal* 'development', etc. apply the same rule.

(3.51) Illustration of gemination (from Ahn and Iverson 2001)

	Underlying form	C-epenthesis	Gemination
a.	ch i k w a | | | | | C V C V V	ch i k w a | | | | | C V C C V V	ch i t k'w a | | |/| | | C V C C V V
b.	ch i k w a | | | | | C V C V V	ch i k w a | | | | | C V C C V V	ch i k' w a | | /\ | | C V C C V V

Ahn (1998) remarked that the option of /t/ between the two syllables *chi* and *kwa* convincingly suggests the epenthesis of a consonant. According to Ahn's (1998) version[14], C is added on the left at the skeletal level in position of tensification of a plain stop. Tensing after a sonorant consonant (e.g. polum/t/al → polum[t']al 'full moon') is explained in the same way because the requirements of Korean syllable structure force selection of the direct gemination alternative. Hence, Ahn and Iverson (2001) characterise Korean (sub-compound) tensing in terms of C-epenthesis as gemination.

(3.52) Gemination (from Ahn and Iverson 2001)

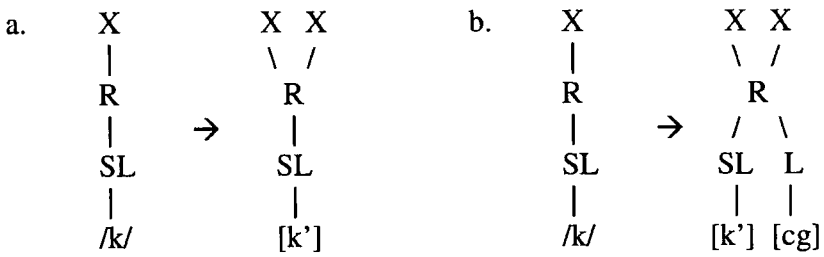
Ø → C / [ ] ___ [ ]

Here I elaborate the change of the phonological representation of /k/ to /k'/ in *chikwa* 'dental clinic' caused by tensification (i.e. gemination) in (3.53) at the non-linear

[14] Although the C-epenthesis was represented for sub-compound tensing in Ahn (1998), I generalise the sub-compound tensing for all the domains of the prosodic hierarchy (proposed by Nespor & Vogel 1982, 1986) in the present study. This is because Ahn and Iverson (2001) remark that a similar account can be offered for the other type of tensification (i.e. predicate tensification, modifier tensification, and Sino-Korean tensification).

level. According to Silva (1992), not only are tense stops underlyingly double-timing slotted, but he also proposes that the feature [constricted glottis] ([cg]) be inserted under the laryngeal node. Based on this, the phonological representation of tensification can be presented as in either (3.53a) or (3.53b). However, I will not argue whether to insert the feature [cg] under the laryngeal node (L) or not, as it is by no means the issue of this thesis and does not make difference in analysing results of the data in Chapter 5. Rather, our attention here is on the timing tier, where the single-slotted timing unit becomes a double-slotted timing unit because, as we will see, the number of timing slots appears to affect the L2A of Korean stops.

(3.53) The phonological representation of gemination in Korean



Owing to the change in the phonological representation, resyllabification is required as we see in (3.54). /k/ in the onset position of *kwa* not only becomes ambisyllabic but also receives one more timing slot (X), attached to the preceding syllable as the coda.

(3.54) Illustration of resyllabification regarding timing units

Underlying form	**C-epenthesis**	**Gemination**
X X X X X | | | | | ch i + k w a | | | | | C V + C V V	X X X X X | | | | | ch i + k w a | | | | | C V C C V V	X X X X X X | | \ / | | ch i k' w a | | / \ | | C V C + C V V

3.3.1.2. Intervocalic Voicing

Intervocalic voicing is known as universal because it appears across languages. It can be inferred through the examples of the intervocalic voicing rule illustrated in Section 3.2.2 that it may be prosodically universal, too, in Korean as the intervocalic voicing rule applies across the domains of the prosodic hierarchy. Therefore, it is assumed that regardless of the difference between the learners' L1s, intervocalic voicing will be successfully acquired. This assumption may be more convincing by looking at the phonological representation of a plain stop after the application of the intervocalic voicing rule in Korean.

(3.55) Intervocalic voicing and the phonological representation of a plain stop

X | R | SL | /k/	→	X | R / \ SL L | | [g] [voice]

For example, /k/ in *swuken* 'towel' intervocalically becomes [g] by the assignment of the feature [voice] as we see in (3.55). The intervocalic voicing rule assigns the feature [voice] to the allophonic variation of a plain stop in Korean so that the underlyingly unmarked plain phoneme /k/ becomes [g]. In this case, no change takes place on the timing tier; that is, the single-slotted timing unit (X) remains the same. Presumably, owing to the stability on the timing tier as well as the laryngeal feature [voice] which is shared in both English and Finnish, the learners may be ready to acquire the intervocalic voicing rule in Korean.

3.3.2. Further Consideration of Compound Tensification and its Exceptions

First, let us look at some examples in (3.56) to consider contradictory phenomena between voicing and tensification.

(3.56) Intervocalic voicing

a. sen	/p/alam	→	sen	[b]alam	'strong wind'
b. ne	/p/aci	→	ne	[b]aci	'your trousers'
c. sayng	/t/alkyal	→	sayng	[d]alkyal	'raw egg'
d. ce	/k/amani	→	ce	[g]amani	'that strawbag'

(3.57) Tensification

a. pom	/p/alam	→	pom	[p']alam	'spring wind'
b. polum	/t/al	→	polum	[t']al	'mid-month moon'
c. pata	/k/acay	→	pata	[k']acay	'sea crab'

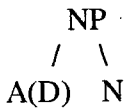
Like Silva's data demonstrated in Section 3.2.2, examples in (3.56a-d) show that Korean plain stops are voiced by following the intervocalic voicing rule. According to Chung (1980), intervocalic voicing takes place in the NP consisting of an adjective (or determiner) and a noun. Chung's statement lets us predict that examples of the 'noun+noun' form in (3.57a-c) are not to be affected by intervocalic voicing. Instead, they are tensified. This is due to '*t*-epenthesis' (C-W Kim 1970), which is a rule to insert *t* between nouns in a compound. Thus, for *pom palam* 'spring wind', *t* is inserted between *pom* 'spring' and *palam* 'wind', and the inserted *t* causes POT. However, the inserted *t* is later deleted by Consonant Cluster Simplification (CCS). Compound Tensification for *pom* /p/*alam* 'spring wind' follows the process to obtain the output *pom* [p']*aram* as shown in (3.58).

(3.58) Process of tensification

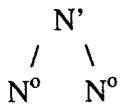
pom	+	palam	
'spring'		'wind'	
[[pom]	t	[palam]]	: t-epenthesis
[pom	t	p'alam]	: POT
[pomp'alam]			: CCS
[pomp'aram]			: Phonetic representation

In light of this, it can be concluded that intervocalic voicing in the NP takes place when the NP is projected to an adjective (or determiner) and a noun whilst the Compound Tensification results from the projection of two nouns, as (3.59) and (3.60) summarises.

(3.59) Voicing (Chung 1980)



(3.60) Tensification



Therefore, it could be predicted that L2 learners' knowledge of the difference between NP and N' may make it possible to achieve the target pronunciation of the noun which is the second part of a constituent. However, before reaching this conclusion, more data of compounds are provided in (3.61) for further consideration of Compound Tensification.

(3.61) More data on Compound Tensification (from Chung 1980)

a. un /p/angwul → un [b]angwul 'silver bell'
   silver bell

b. pom /k/aul → pom [g]aul 'spring and autumn'
   spring autumn

c. emi /t/alk → emi [d]alk 'mother hen'
   mother hen

d. kay /t/ali → kay [d]ali 'dog's leg'
   dog leg

Solely looking at the surface forms, examples in (3.61) may be viewed as compound nouns projecting two nouns under the node of N', which should undergo the rule, *t*-epenthesis[15]. Accordingly, Chung (1980: 31-46) treated the examples as exceptions of tensification. According to his classification of exceptions based on semantic interpretation, in (3.61a), the first element describes the 'shape' or 'material' of the second; in (3.61b), the two elements are parallel; in (3.61c), the first element is in appositive relation to the second, specifying the species, name, or status; and in (3.61d), the first element denotes the possessor of the second element, or the second element denotes a part of the first element.

On the other hand, Ahn (1985) attempted to re-analyse exceptions in (3.61a) by proposing the mechanism of *zero derivation* (or *conversion*). He claimed that the first morpheme in (3.61a) is a derived adjective or determiner transformed from a noun by means of *zero derivation*.

(3.62) a. $[[pan]_N \emptyset\ ]_D$ = $[[half]_N \emptyset]_A$

b. $[[un]_N \emptyset]_D$ = $[[silver]_N \emptyset\ ]_A$

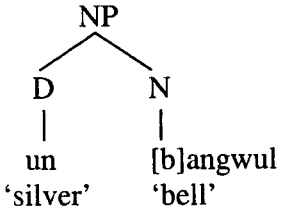
c. $[[kum]_N \emptyset]_D$ = $[[gold]_N en]_A$

He also illustrated the equivalent English counterparts to explain the *zero derivation* process in Korean. By providing a contrast between English and Korean in (3.62), he claimed that *zero derivation* is a Korean-specific phenomenon and that English

[15] If the examples in (3.61) should undergo the *t*-epenthesis rule, they would be mispronounced as following: (a) un *[p']angwul 'silver bell', (b) pom *[k']aul 'spring and autumn', (c) emi *[t']alk 'mother hen' and (d) kay *[t']ali 'dog's leg'.

does not have such a system because English requires a certain suffix for an adjective to be derived from a noun. Therefore, unlike in English, underlying nouns (e.g. *ban* 'half', *un* 'silver', *kum* 'gold' in (3.62)) can take the role of determiners as the consequence of *zero derivation*.

(3.63)



3.4. Implications for L2A of Korean Stops

So far, a general overview of Korean stops has been provided in comparison with English and Finnish stops. Here predications are suggested regarding how the differences of stops in the three languages will affect English- and Finnish-speaking learners in the acquisition of Korean stops. In particular, the distinctive feature and timing slot are considered to deal with implications for L2A of Korean stops in word-initial position, and gemination/resyllabification with regard to phonological domains in the prosodic hierarchy to deal with implications for L2A of Korean stops across word boundaries. In addition, the orthographic symbols of Korean stops are introduced in order to count for orthographic influences in the L2A of Korean stops.

3.4.1. In the Word-initial Position

3.4.1.1. English-speaking Subjects

Recalling Brown's (1998, 2000) studies summarised in Chapter 2, it is expected that English speakers will have difficulties in learning the three distinctive types of Korean stops. This is because English has neither the feature [spread glottis] ([sg]), which distinguishes Korean stop triplets nor geminates, which consists of two-timing slots. If Brown's claim that only L2 phonemes involving features found in the learner's L1 can be acquired, also applies to the acquisition of timing slots, it is expected that English speakers will experience great difficulties in learning Korean tense stops in particular.

3.4.1.2. Finnish-speaking Subjects

Regarding the acquisition of utterance-initial Korean stops, Finnish speakers are predicted to have the same difficulties as English speakers have. As for distinctive features, like English, Finnish does not exploit [sg] for the distinction of stops in the utterance-initial position. Also, geminates are not allowed utterance-initially in Finnish. Although geminates are present in their L1, Finnish speakers might have the same challenge of learning utterance-initial geminates as English speakers do. Thus, it is predicted that no L1 influence will occur in the acquisition of utterance-initial Korean stops by Finnish speakers.

3.4.2. Compound Tensification

Among several types of tensification, the present study specifically looks at the intervocalic tensification of 'noun + noun' compounds, which takes place in the domain of the clitic group in the hierarchy of prosodic constituents (Kang 1992). Implications for L2A of tensification in compounds are suggested by comparing geminates and compounding in English and Finnish with those in Korean. In addition, we will consider how the Korean orthography could influence L2 learners' performance on allophonic variations of Korean plain stops, since a reading task was carried out in the study.

3.4.2.1. Geminates and Compounding in English

Geminates of stops are not allowed in English at all. As for compounding, when two nouns form a compound, the stronger stress is assigned to the first noun (e.g. bOOk shop, chIld birth, sUn rise) (Poldauf 1984). Compounding in English, therefore, is a matter of the stress assignment and is not relevant to a featural change or resyllabification. Therefore, no relevant L1 transfer is predicted in the acquisition of the Korean tensification rule by English speakers.

3.4.2.2. Geminates and Compounding in Finnish

Although geminates of stops do not utterance-initially appear, they do exist in Finnish. Geminates without undergoing resyllabification appear word-internally as we see in (3.64). On the other hand, Nevis (1988: 27) remarked that gemination in Finnish takes place between adjacent full words as shown in (3.64), but never between a stem and its affix, which implies that neither does it occur in 'noun + noun' compounding.

(3.64) Word-internal geminates in Finnish (from Leben 1973, 1980)

output	ku[k]a 'who'	ku[kk]a 'flower'
timing tier	X |	X X \ /
segmental tier	kuka	kuka

(3.65) Examples of 'noun + noun' compounding in Finnish (from Karlsson 1999)

vesi + pullo → vesi[**p**]ullo 'water-bottle'
water bottle

elokuva + teollisuus → elokuva[**t**]eollisuus 'film industry'
film industry

kirja + kauppa → kirja[**k**]auppa 'bookshop'
book shop

Even though gemination (or resyllabification)[16] is not triggered by 'noun + noun' compounding in Finnish unlike in Korean, there are found some other types of gemination similar to Korean; occurring on word boundaries as the result of the word-final *t*-assimilation or even in the intervocalic position as in (3.66a), although optional. This type of gemination appears simply as the indicator of a word boundary, and it may not demand specific syntactic requirements. On the other hand, contrary to POT in Korean, the word-final *t* is not assimilated to the following consonant within words as we see in (3.66c). In Finnish, gemination is also found when adding particles, which is obligatory as in (3.66b). Nevis (1988: 27) stated that the particle clitics behave like independent words, undergoing tensification/gemination.

(3.66) Word-external gemination in Finnish (from Nevis 1988)

a. In the intervocalic position

Vene tulee. [vene**tt**ule:]
boat come
'The boat comes.'

saa-t avata [sa:**tt**avata]
may-2nd person indicator open
'You may open.'

b. Particle gemination

vene -kin [vene**kk**in]
boat -too

tule -pa [tule**pp**a]
come-Emphasis

on-ko [on**kk**o]
is -Question Particle

c. Word-final *t*-assimilation (from Nevis 1988)

Miehet kuolivat. [mieh**ekk**uolivat]
men died
'The men died.'
Sanonut sinu-lle. [sanonu**ssinulle**]
said you-to
'said to you'

[16] Syllabification in Finnish in most cases follows the rule that a syllable boundary is created before every

Jussi ei käynyt-kään kotona. [käny**kk**ä:n]
Jussi not gone-neither home.
'Jussi didn't go home after all.'

cf. pitkä *[pikkä] 'long'
jotka *[jokka] 'which'

Then, how would the similarities between Finnish and Korean gemination affect Finnish speakers' learning the Korean tensification rule? Presence and absence of geminates and gemination in Finnish and Korean are summarised in (3.67) for the discussion of the question.

(3.67) Gemination and phonological domains

Phonological domain	Type of tensification	Korean	Finnish
Phonological word	Word-initial	Yes	No
	Word-internal	Yes	Yes
Clitics group	N # N	Yes	No
	Suffix or Particle	Yes	Yes
Phonological phrase	Modifier	Yes	No
	Word boundaries	Yes (optional)	Yes (optional)

In Finnish, although geminates appear word-internally, gemination does not occur within a non-derived word unlike in Korean. Thus, it can be stated that gemination does not take place in the domain of the phonological word in Finnish whereas it does in

sequence of a single consonant followed by a vowel. (Kalsson 1999: 14)

Korean. On the other hand, gemination is triggered in the domains of the clitic group and of the phonological phrase in both Finnish and Korean although the syntactic environments are not identical to each other.

In sum, Finnish speakers are predicted to acquire the Korean tensification rule for the 'N + N' compounding. The Subset Principle means that although it is absent here in their L1, positive evidence will be available in the L2A of the Korean tensification rule by Finnish-speaking learners since the Finnish gemination is more restricted than the Korean gemination. In addition, Zampini's (1997) study also predicts Finnish speakers' acquisition of it. She suggested that the order of acquisition follows the prosodic hierarchy; that is, the acquisition of prosodic domains will conform to the Subset Principle, so that acquisition within one domain presupposes acquisition in all lower level domains.

3.4.3. Orthographic Influence

3.4.3.1. Korean

The Korean alphabet involves phonetic symbols which consist of fourteen basic consonants and ten basic vowels. Each letter in the Korean alphabet has its unique sound corresponding to each phoneme. The phonemes can vary and be realised as different sounds, constrained by phonological rules, but the orthographic form of a phoneme never changes. Each grapheme assembled with a consonant letter (or consonant letters) and a vowel letter (vowel letters) symbolises a syllable. For example, the word for *tal* 'month' is written as one character, '달' in Korean. 'ㄷ' corresponds to /t/, 'ㅏ' to /a/, and 'ㄹ' at the bottom in the character to /l/.

The orthographic forms of the three distinctive types of Korean stops are illustrated below. They, being different phonemes, are written differently from one another as shown (3.68):

(3.68) The orthography of the three distinctive types of Korean stops

	Korean orthography	Romanisation and meaning		
a.	탈	thal	'mask'	/t^h/
b.	달	tal	'month'	/t/
c.	딸	ttal	'daughter'	/t'/

The symbol of 'ㄷ' in '달' never changes as long as it keeps the meaning of 'month' although what the letter represents may vary according to the phonological environment as we see in (3.69).

(3.69) Korean orthography and allophonic variation

Korean orthography	Romanisation and meaning	Sound of /t/
달	tal 'month'	[t]
이번 달	ipen tal 'this month'	[t']
한 달	han tal 'one month'	[d]

Resyllabification caused by the tensification rule occurring in the native Korean speaker's mind does not change the original orthographic syllable form and preserves the same to maintain the meaning. *Bindung-s*[17] which causes Post-Obsturent Tensing (POT) is often orthographically realised when the first part of 'N + N' ends in a vowel as in

(3.70b). However, tensification still takes place in native Korean speakers' reading regardless of its unchanged orthographical realisation as in (3.70c). Moreover, the speech rate does not affect the rule application.

(3.70) Korean orthography and tensification

Korean orthography	Romanisation and meaning		Sound of /p/
a. 어제 + 밤 : Underlying form	ece + pam	'yesterday' + 'night'	[p]
b. 어젯 밤 : Output of grammatical orthography	eces pam	'last night'	[p']
c.*어제 밤 : Output of ungrammatical orthography	ece pam	'last night'	[p']

Even though there exists a symbol (as in 3.70c) for the 'sound' of the tensified allophonic variation, the orthographic form of the allophone cannot change by the tensification rule. Thus, it may be puzzling for early L2 learners of Korean to pronounce the orthographic symbol written in the form of a plain stop differently from its original sound in reading, particularly when they have been told that the Korean alphabet is a system of phonetic symbols and read as written.

3.4.3.2. English

In English, the relation between the orthography and pronunciation is loose. For example, '*ea*' in *p/ea/r* and *t/ea/r* are realised as different vowels in pronunciation (i.e. [ɛ]

[17] The phenomenon of *bindung-s* is also described as C-epenthesis or as *t*-epenthesis.

and [i] respectively). Examples of consonant symbols are also easily found in English, and some are illustrated in (3.71).

(3.71) Examples of discrepancy between the orthography and pronunciation in English

indivi/d/ual [dʒ]	vs.	en/d/ure [d]
lo/g/ic [dʒ]	vs.	lo/g/ [g]
/c/ycle [s]	vs.	/c/ake [k]
/ch/aos [k]	vs.	/ch/ase [tʃ]
she/ph/erd [p]	vs.	al/ph/a [f]

Although optional, flapping in American English creates a gap between the orthography and pronunciation, too. Thus, having the concept of the loose relationship between spellings and sounds, English speakers might not be disturbed by the orthographic preservation that does not represent Korean allophonic variations.

3.4.3.3. Finnish

Contrary to English, the orthographical realisation is strictly related to each sound of a segment in Finnish. Karlsson (1999: 9) remarks that 'each letter corresponds to one and the same phoneme and each phoneme corresponds to one and the same letter'. Particularly when conjugation (not only for verbs but also for some other word categories) takes place, the letter of the corresponding sound changes even in the stem. *Gradation* can be the representative case, of which examples are demonstrated in (3.72).

(3.72) Examples of consonant gradation in Finnish (from Kalsson 1999)

a. quantitative consonant gradation

kaa<pp>i	'cupboard'	kaa<p>i-ssa	'in the cupboard'
ma<tt>o	'mat'	ma<t>o-lla	'on the mat'
ku<kk>a	'flower'	ku<k>a-n	'of the flower'

b. qualitative consonant gradation

tu<p>a	'hut'	tu<v>a-ssa	'in the hut'
ka<t>u	'street'	ka<d>u-lla	'on the street'
jal<k>a	'foot'	jal<Ø>a-n	'of the foot'
ran<t>a	'shore'	ran<n>a-lla	'on the shore'
ken<k>ä	'shoe'	ken<g>ä-n	'of the shoe'
kul<t>a	'gold'	kul<l>a-n	'of the gold'
par<t>a	'beard'	par<r>a-ssa	'in the beard'
pol<k>e-	'trample'	pol<j>e-n	'I trample'
sär<k>e-	'break'	sär<j>e-n	'I break'
pu<k>u	'dress'	pu<v>u-n	'of the dress'

It is, therefore, presumed that Finnish speakers (particularly in the early stage of learning Korean) might rely on the orthographic symbol (realised as a plain stop) in reading compounds and match their pronunciation with the corresponding letter as they do in their L1.

3.5. Summary

Firstly, the characteristics of the three distinctive types (i.e. *aspirated*, *plain* and *tense*) of Korean stops were examined with respect to manner of articulation, VOT and

phonological representations. They were compared to stops in English and Finnish, both of which categorise the type of stops in two ways; voiceless vs. voiced. In terms of aspiration, aspirated stops (i.e. /p^h, t^h, k^h/) are the most heavily aspirated with 105ms of the mean VOT value, and tense stops which are not aspirated (i.e. /p', t', k'/) the least with 13 ms of the mean VOT value. The mean VOT value of plain stops which are slightly aspirated (i.e. /p, t, k/) is 61 ms, being intermediate between aspirated and tense stops. The VOT values of Finnish unaspirated voiceless stops are almost identical to Korean tense stops. Also, the VOT values of voiced stops in English and Korean[18] are very close to those of Korean tense stops. Different from Finnish voiceless stops, the mean VOT value of English voiceless stops are closer to Korean plain stops.

(3.73) VOT values of Korean, English and Finnish stops in order
(The stops with the biggest mean VOT values are shown on the most left side.)

Korean aspirated > English voiceless > Korean plain > Finnish voiceless, Korean tense,
(105ms) (69ms) (61ms) (13ms) (13ms)
Korean voiced, English voiced
(12ms) (9ms)

As for phonological representations, the three types of Korean stops are differentiated by the distinctive feature [spread glottis] and the number of timing slot on the skeletal tier: The phonological representation of aspirated stops includes the feature [spread glottis] under the laryngeal node, and the phonological representation of tense stops is unique, specifying a double-timing slots on the skeletal tier. Voiceless and voiced stops in English are differentiated by the distinctive feature [aspirated] whereas unaspirated voiceless and voiced stops in Finnish by the distinctive feature [voiced]. In

[18] Suomi (1980) describes Finnish voiced stops as 'fully voiced' rather than providing their numeric values.

both English and Finnish, the number of timing slots is not counted for to distinguish the types of stops. The differences of phonological representations of Korean, English and Finnish stops will be utilised for the discussion of this study's data to support the hypothesis that the acquisition of segmental phonology is more than the physical matter of articulation and involves mental representations (including phonological rules and principles).

Secondly, allophonic variations of Korean plain stops were examined with regard to syntactic conditions; Post-Obstruent Tensing (POT), Compound Tensification, Predicate Tensification, Modifier Tensification, Sino-Korean Tensification, Intervocalic Voicing and Aspiration. Among those allophonic variations, Compound Tensification and Intervocalic Voicing were focused on to look at the stops which are constrained by syntax. The tensification in compounds, which is a Korean-specific phenomenon, is caused by resyllabification across word boundaries. On the contrary, intervocalic voicing is considered universally-distributed among languages and transforms 'slightly aspirated' plain stops to voiced sounds across word boundaries. The contrast of the two phonological rules is expected to show that the difficulty of mastering L2 phonology lies on the complexity of phonological rules interfering more than one grammatical component (particularly those constrained by syntax), supporting the hypothesis mentioned above. Assisted by the two aspects (i.e. phonological representations and allophonic variations constrained by syntax) of stops described earlier in this chapter, I intend to show that the difficulty of attaining native-like L2 phonology is attributed to the incomplete acquisition of phonology in the learner's mind rather than to a physical matter.

Lastly, based upon the differences between Korean, English and Finnish stops, predictions in L2A of Korean stops by English- and Finnish-speaking learners were suggested. They are summarised in (3.74) and (3.75).

(3.74) Predictions for English-speaking learners

P1. English speakers will be confused in distinction of the three distinctive types of Korean stops (i.e. aspirated, plain and tense) due to lack of the feature [spread glottis] and double-timing slots (XX) in their L1 grammar.

P2. No L1 transfer will occur in English speakers' acquisition of Korean tensification rule due to lack of geminates or gemination in English.

P3. English speakers will not be influenced from the Korean orthography owing to the concept of a loose relationship between spellings and sounds in their L1.

(3.75) Predictions for Finnish-speaking learners

P1. Finnish speakers will be confused in distinction of the three distinctive types of Korean stops (i.e. aspirated, plain and tense) like English speakers because they lack the feature [spread glottis] and double-timing slots (XX) in word-initial position in their L1 grammar.

P2. Finnish speakers will acquire the Korean tensification rule for the 'N+N' compounding because Finnish gemination is more restricted than Korean gemination.

P3. Finnish speakers will be heavily influenced from the Korean orthography because of the tight relationship between spellings and sounds in their L1.

The three predictions for English-speaking learners will be addressed as EP1, EP2 and EP3, and those for Finnish-speaking learners as FP1, FP2 and FP3 hereafter. In addition, predictions regarding development in the L2A of Korean stops by both English- and Finnish-speaking learners are stated in (3.76) and will be addressed as P4 and P5 in the following chapters. These predictions are suggested with regard to previous studies on L2A of phonology, which were summarised in Chapter 2.

(3.76) Predictions for development in the L2A of Korean

P4. In consideration of Brown (1998, 2000), it is predicted that English- and Finnish-speaking learners will not show development in the L2A of word-initial Korean stops because their L1 stops lack the feature [sg] and double-timing slot in word-initial position.

P5. In consideration of Young-Scholten (1994), it is predicted that Finnish-speaking learners will show development in the acquisition of the tensification rule under the Subset Principle.

Having overviewed Korean stops in comparison with English and Finnish stops and considered the implications for the L2A of Korean stops by English- and Finnish-speaking learners, we now turn to describe the experiment carried out in this study. This will be done in the following chapter.

4. The Methodology

The present study attempts to unravel the mystery of difficulty to achieve native-like pronunciation in adult L2A, hypothesising that the difficulty in adult L2 phonology may be influenced more strongly by prosodic factors than phonetic ones. Therefore, an experiment was designed to test those stop segments in Korean constrained by syntactic conditions as well as those in the utterance-initial position where phonological rules are not involved. The experiment consists of three tasks; 'Segmental Discrimination' (perception), 'Picture Naming' (production) and 'Reading Compounds from Flash Cards' (production). The task for perception was carried out as the attempt to detect whether L2 learners' phonological representations of Korean stops influence the production. The tasks of 'Segmental Discrimination' and 'Picture Naming' are expected to evaluate EP1 and FP1 and the task of 'Reading Compounds' EP2 and FP2, the predictions suggested in the previous chapter. The three tasks are described one by one after the details of the research subjects are provided.

4.1 Research Subjects

The study included three language groups (English, Finnish and Korean as the control group) of research subjects. Thirteen British English speakers and fifteen Finnish speakers were investigated in order to look at the acquisition of the three Korean stop triplets; plain stops /p, t, k/, aspirated stops /p^h, t^h, k^h/ and tense stops /p', t', k'/. The thirteen English- and fifteen Finnish-speaking subjects were labelled with numerical digits from E-1 to E-13 and from F-1 to F-15 ('E' stands for English-speaking learners

and 'F' for Finnish-speaking learners), respectively. The English and the Finnish subjects were divided into three groups according to their amount of exposure ('Inexperienced I', 'Inexperienced II' and 'Experienced'). Five English-speaking subjects from E-1 to E-5 and five Finnish-speaking subjects from F-1 to F-5 belong to the group of 'Inexperienced I', five English-speaking subjects from E-6 to E-10 and five Finnish-speaking subjects from F-6 to F-10 to the group of 'Inexperienced II' and three English-speaking subjects from E-11 to E-13 and five Finnish-speaking subjects from F-11 to F-15 to the group of 'Experienced'.

Data from 12 English speakers were collected either at the University of Durham, at the University of Newcastle or at SOAS (School of Oriental and Asian Studies), England, and E-13, who had started learning Korean upon her arrival in Korea provided her data in Korea. The Korean language was taught two hours per week at the University of Durham and five hours per week at the University of Newcastle and SOAS for each level during a nine-week term by a native Korean speaker, and there are three terms in a year. All the 15 Finnish speakers participated in the data collection at the University of Helsinki, Finland, where the Korean language was taught three hours per week during a fourteen-week semester by a Korean native speaker, and there are two semesters in a year.

Although the subjects have been divided into three groups according to the length of exposure to Korean (i.e. 'Inexperienced I', 'Inexperienced II' and 'Experienced'), the issue of the developmental stage in the L2A of Korean stops is not closely examined in this study. This is because the length of subjects' exposure to Korean in the present study may be regarded too short to observe development in the L2A of Korean (see Section 5.4.3 in Chapter 5.). Still, the developmental stages are not completely ignored in

analysing data. The main point of the reason why the English- and Finnish-speaking subjects have been divided into three different groups respectively is to show that the subjects have been carefully selected to make as a close match to each other (i.e. English-speaking subjects vs. Finnish-speaking subjects) as possible. By doing so, we will be able to see the difference and similarity in the L2A of Korean stops between English and Finnish speakers and to grasp better insight for what causes the difficulty in acquiring L2 pronunciation.

'Inexperienced I': Five English and five Finnish speakers in the group of 'Inexperienced I' learnt Korean for one year at the University of Durham, at the University of Newcastle or at SOAS, England and at the University of Helsinki, Finland, respectively. None of them had been to Korea before the time of testing. Two of the English subjects, E-1 and E-2, had been studying Chinese at university for four years, and had spent a year in Beijing, China during their university education. The other two English subjects, E-3 and E-4, had been studying Japanese at university for four years, and had spent a year in Tokyo, Japan during their university education. E-1, E-2, E-3 and E-4 were provided with two hours of formal Korean lessons per week during the term. The last subject, E-5, had been studying Thai and Korean at the university for one academic year. E-5 had five hours of formal Korean lessons per week during the term.

As for the Finnish subjects, two of them, F-1 and F-4, were majoring in Korean Studies and had not learnt any other Asian languages before. F-2 and F-5 had been learning Korean as an option module and had not learnt any other Asian languages before. F-3 reported that he had studied Indonesian for one year before Korean and had been studying Chinese for three years at university. All the Finnish subjects were provided

with three hours of formal Korean lessons per week during the term. The English subjects' ages at the time of testing ranged from 22 to 24, and the Finnish subjects' ages from 20 to 29.

'Inexperienced II': Five English speakers in the group of 'Inexperienced II' had learnt Korean for two years at the University of Durham, at the University of Newcastle or at SOAS. E-6 and E-7 had been studying Japanese for four years and E-8 for three years at university, and they lived in Tokyo, Japan during their university education. E-6 visited Korea for four days and E-7 for three days while they lived in Japan. They had two hours of formal Korean lessons per week during the term, and the other three subjects five hours per week on average. E-7 and E-8 went to a local school in Japan for one year when they were in their late teens. And E-9 and E-10 had not learnt any other Asian languages before. The ages of the English subjects at the time of testing ranged from 20 to 24.

As for the Finnish subjects in the group of 'Inexperienced II', four of them studied Korean for two years at the University of Helsinki and one for three years. F-6 majored in Korean Studies and had studied Chinese for one academic year. F-8 had been studying Japanese for three years at university. F-10 had been studying Chinese for four years at university and had a tour in China for one month and in Korea for three weeks. F-7 and F-9 did not have any knowledge of other Asian languages. F-7 took a summer language course for one month in Korea, and F-9 visited Korea five times before the time of testing. All the Finnish learners were provided with three hours of formal Korean lessons per week during the term. The ages of the Finnish subjects at the time of testing ranged from 21 to 27.

'Experienced': Three English and five Finnish learners of Korean in the group of 'Experienced' had a formal Korean language course for at least one academic year in Korea, and lived in Korea between one and three years in total. During the Korean language courses, they had to attend at least five hours of Korean classes every day. Here are the individual details, beginning with the English subjects. In England, E-11 and E-12 had approximately five hours of formal Korean lessons per week. E-11 had been studying Korean at university for four years until the time of testing and had lived in Korea for one academic year during the university education. E-12 had studied Korean at university and lived in Korea for two years in total (for one year during the university education and for another year after graduation). E-13, who had studied Japanese at university, started learning Korean upon her arrival in Korea. She had been continuously living in Korea for two years at the time of testing.

F-11, one of the Finnish subjects, had studied Korean in Korea for one year before taking the Korean module at the University of Helsinki. The test was given to F-11 at the end of the course that she had attended for one year at the university in Finland. F-12 had majored in Korean Studies for four years and was learning Japanese at university at the time of testing. F-12 had lived in Korea for one year during his/her university education. F-13 had studied Korean for two years, majoring in Japanese at university before living in Korea for one year. F-14 had studied Korean for two years before going to Korea for one academic year and also had studied Japanese for three years at university. F-15 had studied Korean for two years before going to Korea for the first time. F-15 reported that he had visited Korea several times and stayed in Korea for almost three years in total. While they studied Korean in Finland, all the Finnish learners had three hours of formal

Korean lessons per week at the university. The ages of the English subjects at the time of testing ranged from 25 to 28, and the ages of the Finnish subjects from 25 to 35.

The 28 English and Finnish subjects had all started learning Korean at university. Before then, they hardly had the opportunity to be exposed to Korean. Except for F-12 and F-15, all other subjects (both English and Finnish) were taught by a native Korean speaker when they started learning Korean in their native countries. However, F-12 and F-15 had been taught by a native Finnish speaker for two years before they went to Korea. It should be pointed out that the English and the Finnish subjects are not balanced with respect to their foreign language experience, with the English subjects having studied other Asian languages. But we also have to consider that the Finnish subjects started learning English and Swedish at school at the age of around 10 years, and they have been exposed to English and Swedish on TV since even before the start of formal education.

Recalling Brown's (1998 and 2000) studies, in which the Japanese research subjects had been exposed to the target language in their early teens but did not show an advantage of early exposure or of length of learning English, I assume that it may not be necessary to address the influence of the subjects' additional L2 background in this study. Moreover, even if the Finnish subjects have managed to acquire English at a high level, I assume that this cannot affect the acquisition of Korean stops which are distinguished by the Korean specific feature [sg] and timing unit.

Apart from the 28 subjects described above, two additional subjects participated in the experiment in England. However, their data was discarded because one of them reported that he was an English and French bilingual and the other had been exposed to

Korean since her birth. Besides, data from F-11, one of the 15 Finnish-speaking participants in the auditory (perception) task was excluded in the analysis of the production data. This is because it was reported that she had hardly interacted with Koreans in Korean. Owing to her experience of living in Korea for one year, she was classified into the group of 'Experienced' but had hardly spoken in Korean, unlike the other subjects in the same level of the group. I consider that F-11, 'production'-wise[18], has not practised speaking Korean sufficiently enough to be included in the group of 'Experienced' nor was she inexperienced; therefore, I have not included the data from F-11 in group analysis. This reasoning is based upon the report that production in L2A can improve in accordance with the amount of practice of the target pronunciation unlike in L1A (Smith 2000). Smith (2000) argues that kinetic feedback during production provides crucial information regarding whether the learner has produced the correct sound based strictly on the feel in the mouth without relying on the perceptual system. That is, although adult learners may have a developed motor control system, oral practice is required to achieve target pronunciations. In addition, this study presupposes that production is independent of perception (Sheldon & Strange 1982; Smith 2001); thus, F-11's perception data, owing to the length of exposure to the natural input of Korean, are considered valid so as to take part in the group of 'Experienced' whilst her production data are discarded.

As a control group, ten Koreans from Seoul, where standard Korean is spoken, were included in the tasks of 'Segmental Discrimination' and 'Picture Naming'. Data from four of them were collected in England, another four in Finland and the last two in Korea.

[18] F-11's segmental production data will be presented in the tables in Section 5.2 of Chapter 5, as one might want to compare these data with her perception data in Section 5.1 of Chapter 5.

Korean controls accurately performed at the level of 100% without a single mistake in the perception task, and their production data were judged as 100% correct by a native Korean judge.

At the end of the three tasks, each subject was requested to fill in a questionnaire. A copy has been included in Appendix 4. This questionnaire aimed at obtaining individual information about his or her native language and foreign language experience and to determine the validity of data provided for the study. All the participants in the experiment reported having normal hearing. Individual details of the subjects are provided in Tables 4.1 and 4.2, and the summaries are in Tables 4.3 and 4.4.

Table 4.1 Individual information of English subjects

		Age at the time of testing	Foreign languages	Length of living in Korea
Inexperienced I	E-1	23	Mandarin, French, German, Taiwanese	--
	E-2	22	Mandarin, Cantonese, French, German, Latin	--
	E-3	22	Japanese, French, German	--
	E-4	24	Japanese, French, German, Italian	--
	E-5	22	Thai	--
Inexperienced II	E-6	24	Japanese, French, German	4 days
	E-7	23	Japanese, French, Spanish, Italian	3 days
	E-8	23	Japanese, French, Italian, Latin	--
	E-9	20	Welsh, French, German	--
	E-10	20	German, Dutch	--
Experienced	E-11	25	French	1 year
	E-12	25	French, German, Spanish	2 years and two short trips
	E-13	28	Japanese, French	2 years

Table 4.2 Individual information of Finnish subjects

		Age at the time of testing	Foreign languages	Length of living in Korea
Inexperienced I	F-1	28	English, Swedish, German	--
	F-2	25	English, Swedish, German	--
	F-3	29	English, Swedish, Spanish, French, German, Chinese, Indonesian	--
	F-4	20	English, Swedish, French, German	--
	F-5	21	English, Swedish, French, Spanish	--
Inexperienced II	F-6	21	English, Swedish, French, German	--
	F-7	22	English, Swedish, French, Spanish	1 month
	F-8	24	English, Swedish, Japanese	--
	F-9	27	English, Swedish, German	Five short trips
	F-10	24	English, Swedish, French, Russian, Chinese	3 weeks
Experienced	F-11	25	English, Swedish, French, German	1 year
	F-12	25	English, Swedish, German, Spanish, Italian, Russian	1 year and three one-month visits
	F-13	26	English, Swedish, German, Japanese	10-day trip, 10-month study and 3-month working
	F-14	25	English, Swedish, Japanese	1 year
	F-15	35	English, Swedish, German	Twice for 14 months and frequent visits

Table 4.3 Subject information of age and years of study

Group	Mean age at testing	Mean age of exposure	Mean years of studies	Mean years in Korea (Experienced learners)
English	22.92	21	2	1.67
Finnish	25.15	22.46	2.67	1.4
Controls	27	--	--	--

Table 4.4 Summary of subject information at each level

	Inexperienced I	Inexperienced II	Experienced
No. of Subjects	5 English and 5 Finnish	5 English and 5 Finnish	3 English and 5 Finnish
Mean Years of Exposure to Korean	1 year	2 years	*1.84 years for English and 2.04 years for Finnish
Type of Input	Taught by a native Korean speaking teacher at university for one year	Taught by a native Korean speaking teacher at university for two years	Took a Korean language course in Korea at least for one year *The mean years indicate the length of subjects' living in Korea.

4.2. Tasks

Three tasks were used with the research subjects one by one in the study: firstly, a perception task for 'Segmental Discrimination', secondly, a production task involving 'Picture Naming' and lastly, another production task involving 'Reading Flash Cards (or Compounds)'. The three tasks are described in detail in the following sections.

4.2.1. Segmental Discrimination (Perception)

4.2.1.1. Test Materials and Procedure

Twenty seven syllables in the form of CV were recorded into an MD player (Panasonic FE9LF09096) by the experimenter, who speaks standard Seoul Korean. The three Korean triplet phonemes (i.e. /p, p', p^h/, /t, t', t^h/ and /k, k', k^h/) were combined with a simple vowel, either /a/, /e/, or /u/ in order to assemble a syllable. The triplet phonemes combined with the vowel /a/ were presented to the subjects first, with /e/ next and lastly with /u/. The consonant phonemes were randomised in order within the same vowel group. (The transcribed task material is presented in Appendix 1.)

The twenty-seven stimuli were presented one by one to match one out of three sounds in the same group of triplet stop phonemes by listening to the recorded sounds from the MD player through a set of earphones. For instance, to discriminate the sound [ka], [ka] was first presented, followed by three sounds, including the same sound as the stimulus, which are CV syllables. C is one of the stops belonging to the same group, and V is the same vowel used in the target sound (e.g. [ka], [k'a] and [k^ha]). Examples are illustrated in (4.1). Each subject was tested individually in a quiet room, and the subjects were asked to mark the column 'Not sure' in case of uncertainty.

(4.1) Examples of the 'Segmental Discrimination' task

Stimuli	Choices		
1. [ka]	A. [ka]	B. [k^ha]	C. [k'a]
2. [p^ha]	A. [pa]	B. [p'a]	C. [p^ha]
3. [ta]	A. [t^ha]	B. [ta]	C. [t'a]

4.2.1.2. Rationale for the Task of Segmental Discrimination

Perception Task: I examined the perception of Korean stops to investigate phoneme contrast discrimination by L2 learners before investigating production of them, noting the findings that L2 learners may be able to accurately produce a non-native contrast even though the same learners are unable to distinguish the two sounds perceptually (Brière 1996; Flege 1995; Goto 1971; Sheldon and Strange 1982). Since adult learners have a developed motor control system, they are often able to execute the necessary articulations. With the support of Korean orthography, the instructed learner in the classroom can accurately produce the correct sound, thus giving the appearance of having acquired the contrast. Therefore, as Brown (1998: 157) remarked, if we rely on production data we may be misled to attribute more segmental structure to a learner's underlying phonological competence than he or she actually has. On the other hand, some L2 learners are unable to correctly produce a novel contrast in spite of their ability to perceive that contrast, in which case we would underestimate the learner's competence.

Departing from VOT Research: In order to examine the acquisition of stop phonemes, numerous studies have used the means of voice onset time (VOT) measurements for both perception and production experiments. However, this particular study departs from the VOT perception research by presenting natural native Korean speaker's voice as stimuli in the experiment. I avoided using sounds generated by speech synthesis for the following reasons. Firstly, I assume that language acquisition is stimulated by natural input produced by humans, and that the learner generates his/her grammar (even the interlanguage, too) via the language acquisition device (LAD). Thus,

I prefer using the target language speaker's utterances to test L2 learners' perception ability. Secondly, it is phonological representations including distinctive features in the L2 that are investigated in this study, rather than the difference between L1 and L2 speakers' VOT values. Native Korean speakers categorically perceive Korean stops, which can be phonologically classified into the three different categories of *Aspirated*, *Plain* and *Tense* by distinctive features and other phonological factors. I assume that the distinction between Korean stops may not solely lie in discrimination of VOT values but may rather be more relevant to the phonological acquisition of distinctive features and phonological rules in Korean. In addition, the acoustic study by Cho, Jun and Ladefoged (2002), which examined native Korean speakers' stop production mentioned that VOT values might not be the crucial cue for native Korean speakers to perceptually discern the three distinctions of stops in Korean. Furthermore, from my understanding of the literatures reporting VOT values of English /b, d, g/ and Korean /p', t', k'/, they appear very close to each other as far as concerning the VOT measurements alone, despite the fact that they are classified into two distinctive types of sound qualities. That is, English /b, d, g/ are voiced, but Korean /p', t', k'/ are unaspirated voiceless sounds.

Curtin, Goad and Pater (1998: 392) also avoided using VOT measurements in exploring the perceptual acquisition of Thai stop phonemes by English and French speakers. Opposed to the phoneme identification and discrimination tasks used in the VOT research, they stated that those tasks measure only the identification of sounds with native language categories and the ability to distinguish minimally different sounds. The contrast under their investigation was restricted to onset position in the shape of CVC, as it is in this study.

Non-lexical CV Syllables: I should also provide a reason for why non-lexical CV forms were presented to the subjects rather than lexical minimal pairs in the auditory experiment. This study specifically looks at the acquisition of Korean 'stop phonemes' independent of any other factors such as syllable structure, consonant clusters, lexical representation, etc. I also intended to prevent the subjects' perception from being affected by their lexical knowledge (Yamada, Kobayashi and Tohkura 1997), assuming that the stop in a non-lexical CV form may be the most appropriate way to examine its segmental information alone.

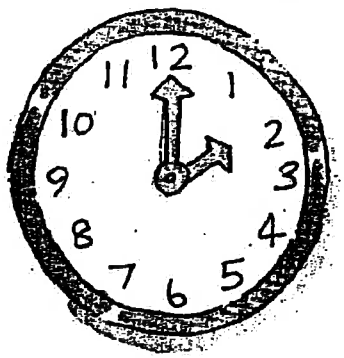
'Not Sure': Finally, I must point out why 'Not sure' was added in the answer sheet. I assumed that the English and Finnish learners of Korean would be unable to respond to the stop stimuli with confidence all the time, whether the answer is correct or not and sometimes (or often) might be confused, having no clue, among the three distinctions. For example, he or she may hear the three distinctive stops the same (this is easily observed in the Korean class. Students have reported that they do not hear the differences of the three types of Korean stops, especially before learning the Korean alphabet.) and then still mark one as a guess in the answer sheet, the results will appear random rather than systematic. Thus, to reduce the possibility that the subjects randomly chose one out of the three different types of stops, the column 'Not sure' was added in the answer sheet.

4.2.2. Picture Naming (Production)

4.2.2.1. Test Materials and Procedure

Production data were collected immediately after the auditory task. The research subjects were presented with twenty-seven pictures one at a time and asked to name the picture in one word. The twenty-seven lexical items contained Korean stop sounds in word-initial position. In order to avoid other possible answers and lead the subjects to the correct answers, a cue was provided in English at the bottom of each picture as demonstrated in (4.2).

(4.2) Examples of the 'Picture Naming' task

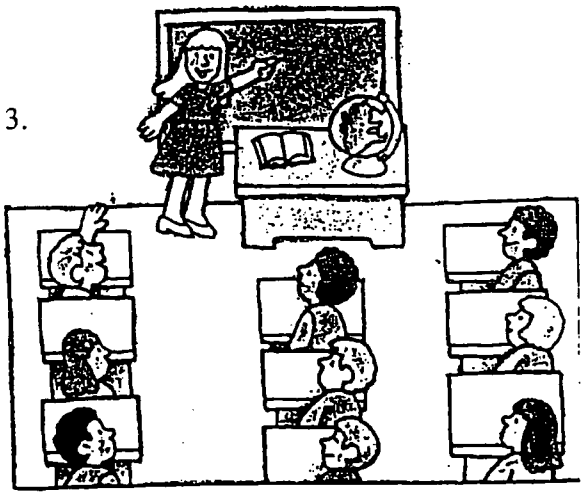
1. 

two o'clock

2. 

boiled rice

3.



to teach

The twenty-seven words for the presented pictures included nine aspirated, nine plain and nine tense stops in the onset position. The three types (i.e. aspirated, plain and tense) of Korean stops were randomised in order among the twenty-seven words, and the pictures were presented in the same order to all the research subjects. Before the task, the experimenter showed the twenty-seven pictures to the subjects in order to check if they knew the test words. In case a subject had not learnt any of the test words, the experimenter told him/her what the pictures were before recording. The speech of each subject was individually recorded into an MD player (Panasonic FE9LF09096) through a microphone (Sony ECM-MS907) in a quiet room.

4.2.2.2. Rationale for the Task of Picture Naming

Lexical items presented in the picture naming task: If I had chosen non-lexical items for the production task, it would have been inevitable to have the research subjects read *Hangul* (the Korean alphabet), which visually shows the distinctions of the three types of Korean stops. From the influence of orthography, the subject can make an extra conscious effort to accurately produce the correct pronunciation in the task, thus giving

the appearance of having acquired the contrasts. Hence, this study has chosen to use lexical items so that they may be produced as a mean of naming the pictures presented to the subject.

Transcribed by the experimenter: It has been recently a trend to adopt an acoustic investigation by measuring VOT values in order to examine word-initial stops; however, this study departs from VOT values and chooses the method of a native Korean speaker's transcribing data in order to examine the L2 Korean stop acquisition in a few ways. Firstly, I emphasise that VOT values might not be the crucial cue for native Korean speakers to discern the three distinctions of stops in Korean (Cho et al. 2002). For example, VOT values of English /b, d, g/ and Korean /p', t', k'/ appear very close to each other despite the fact that they are classified into two different types of sound qualities; that is, English /b, d, g/ are voiced, but Korean /p', t', k'/ are unaspirated voiceless sounds. Thus, the distinction of Korean stops may not be solely attributed to the degree of VOT values. Secondly, native Korean speakers categorically perceive the three distinctive types of Korean stops. In other words, native Korean speakers categorise stops into one of the three distinctive types (i.e. aspirated, plain and tense) and do not hear them beyond the three categorisations in the Korean consonantal inventory. Therefore, each stop sound of the collected L2 data is to be heard as and classified into one of the three types by the native Korean judge. Thirdly, on the grounds that the 10 native Korean speakers of the control group, who all come from Seoul, performed 100% correctly in the perception task, I am convinced that the native Korean-speaking judge should be reliable to precisely judge the three distinctions of Korean stops.

In short, I emphasise that this study examines whether L2 learners of Korean are able to distinctively produce the three types of Korean stops despite the fact that their L1s have only two-way stop distinctions. VOT values are by no means the concern of this study. Therefore, for this type of L2 production study, I presume that it may be more appropriate to have a native Korean speaker judge the L2 production data than to use acoustic tools such as VOT measurements. In this study, the author transcribed data collected from the English- and Finnish-speaking subjects. The author is a native Korean speaker who was born and brought up in Seoul, where the standard Korean is spoken. She has been teaching Korean as a second language at universities in Korea, England and Finland since 1995.

4.2.3. Reading Compounds in Flash Cards (Production)

4.2.3.1. Test Materials and Procedure

Research subjects were individually given a compound word reading task. The task consisted of thirty pairs of flash cards. The second parts of the tested compounds were arranged on the table in front of the subject. In order to prevent visual preparation for reading the next word, the experimenter (the author) randomly put the first part of a compound next to the second part one by one. All the flash cards used in the experiment were so constructed as to divert the subjects' attention from the control of pronunciation during their performance. Twenty out of the thirty compounds that each subject read involved tensification. As distracters, five compounds applying to intervocalic voicing and one compound applying to POT as well as four nonce words were seeded in the production task. The subjects were asked to read the two adjacent flash cards together

aloud at normal speech speed, and their speech was recorded into an MD player (Panasonic FE9LF09096) through a microphone (Sony ECM-MS907) and subsequently transcribed. Immediately after the reading task, the subjects were asked to translate the thirty compounds so as to see if there was a relation between the learners' correct pronunciation and knowledge of the meaning, through which they may have the syntactic information of the compound. All the compounds were presented on a sheet of paper, and the subjects had to write the meaning either in English or in Finnish on a different sheet of paper.

4.2.3.2. Rational for the Task of Reading Flash Cards

Reading task: I avoided using the method of reading words for the production task of utterance-initial stops. Instead, I chose the picture naming task for the reason that from the influence of orthography, the subjects make extra conscious efforts to accurately produce the correct pronunciation. It may be impossible to eradicate orthographic influence as long as reading materials are used in the experiment. In the case of the reading task in this study, the orthographic influence may be particularly caused by the letters of plain stops, as they orthographically remain the same where the sound changes as an allophonic variation. The same applies in intervocalic voicing in Korean. This unchangeable orthographic aspect of the two contrasting phenomena (i.e. tensification vs. intervocalic voicing) in Korean can be an advantage for the task of reading compounds. That is, if the learners have acquired the tensification rule, they will produce tense stops despite the orthographic symbols representing plain stops. However, if the learners have acquired neither the tensification rule nor the intervocalic voicing rule, they will continue

to produce plain stops based on influence from the Korean orthography. On the other hand, if their interlanguage grammar includes only the universal intervocalic voicing rule which is purely constrained by the phonological environment and belongs to the P2 level, they will produce voiced stops in the position where the tensification rule is applied regardless of the orthographic symbols representing plain stops.

Relation between tensification and tense stops: As for the relation between producing tense stops and having the knowledge of the tensification rule, one might assume that the acquisition of tense stops is a requirement in order to test the acquisition of the tensification rule. It might be assumed that the learners are not able to produce target tense stops although they have the knowledge of the tensification rule in mind. However, I do not believe that evidence of tense stop production is related to evidence for the acquisition of the tensification rule. This is mainly because 'it is not just ability (or lack thereof) to produce an individual segment that results in a second language accent; a second language learner must also be able to combine the segments in the sequences demanded by the target language' (Young-Scholten and Archibald 2000: 64).

For example, Riney and Flege (1998) observed the difference between Japanese speakers' production of word-initial /r, l/ singletons (as in *rag*, *last*, etc.) and /r, l/ in clusters (as in *train, cream, play, sleep*, etc.). The subjects were tested twice 42 months apart. The /r/ singletons received lower scores than /r/ in clusters in both tests (37% vs. 79% at the first test and 53% vs. 68% at the second test) whilst the /l/ singletons received higher scores than /l/ in clusters (73% vs. 28% at the first test and 87% vs. 68% at the second test). The gaps between the scores of /r, l/ singletons and clusters achieved in the

first test were significantly large, which can be taken as an example showing that producing a single segment does not guarantee its production in a different environment.

Accordingly, I assume that production of a tense stop in the intervocalic position of allophonic variation should be treated separately from production of a tense stop in utterance-initial position. If showing the acquisition of the tensification rule is closely related to the production of tense stops, we would fall into the following scenario: Results from the data of reading compounds would have to be almost identical to the results for the picture naming task which was carried out to investigate the production of utterance-initial tense stops in case that learners had acquired the tensification rule and struggled to achieve correct pronunciation. We will see what the results from the task of reading compounds are and discuss the relation between the acquisition of tensification and the ability of producing tense stops with the results we get later.

Departing from VOT research: Flege and Davidian (1984) transcribed final stops in minimally paired English words ending in /b, d, g/ and /p, t, k/ which had been produced by English, Spanish and Taiwanese speakers. Their study looked at the segmental production errors that arise from phonological differences between English and non-native subjects' L1, being aware that Taiwanese permits /p, t, k/ but not /b, d, g/ in word-final position and Spanish devoices phonologically voiced stops in utterance-final position. They also took into account the Spanish phonological rule that the few word-final stops tend to be spirantized or omitted. I assume that counting for such 'phonological' aspects, their study might not have needed to demand acoustic investigation of the English word-final stops.

Dealing with allophonic variation of stops involving some prosodic/postlexical phonological rules, I chose the method of a native Korean speaker's transcribing data as in the investigation of utterance-initial stops. I, here, particularly re-emphasise that VOT values of /b, d, g/ (i.e. intervocalically voiced Korean plain stops and English voiced stops) and /p', t', k'/ (i.e. Korean tense stops) appear very close to each other, despite the fact that they are classified as two different types of sound qualities; that is, /b, d, g/ are voiced, but /p', t', k'/ are unaspirated voiceless sounds. It is, therefore, seemingly inadequate to use measurements of VOT values for the purpose of examining allophonic variations of intervocalically-positioned plain stops. The author, who had transcribed data of utterance-initial stops, also judged the L2 speech data of allophonic variations in the type of a 'N + N' compound.

4.3. Summary

Stop segments in word-initial position are examined through the tasks of 'Segmental Discrimination' and 'Picture Naming'. The perception task of 'Segmental Discrimination', in particular, has been designed to detect the phonological representations of stop phonemes in the L2 learners' mind in order to see how they can affect production of Korean stops. The production task of 'Picture Naming', therefore, has been designed to make parallel with the perception task by looking at stop segments in word-initial position, too. It was predicted that the difficulty of acquisition of Korean stops would be caused by Korean-specific phonological representations of stops such as the feature [sg] and double-timing slots 'XX' in Section 3.1.2, Chapter 3.

Furthermore, it was also hypothesised that the difficulty of L2 pronunciation is not only a matter of acquiring phonology of a segment on one level. In other words, phonology is not confined only in its grammatical component (See (1.1) in Chapter 1.), but it also interacts with other grammatical components. Similarly, the prosodic hierarchy proposed by Nespor and Vogel (1982, 1986) has been introduced in Chapter 1 in order to explain the complexity of phonology. Because the nature of phonology is hierarchical as shown in (1.2) in Chapter 1, all the relevant rules and principles of a segment in each domain must be acquired for the target pronunciation. Thus, the task of 'Reading Compounds' has been designed to test Korean stops involved in phonological rules constrained by syntax beyond the limit of the phonological component or in a higher domain in the prosodic hierarchy. It is predicted that L2 learners of Korean will find it more difficult in acquiring stops in compounds than acquiring stops in word-initial position, due to the phonological complexity which lies across grammatical components or prosodic domains. Yet, the present study, by no means, implies that the more difficult it is to acquire the phonological grammar, the higher in the prosodic hierarchy the domain must be, as Zampini (1997) suggests an order in the acquisition of phonological domains that obeys the prosodic hierarchy. I do not intend to investigate the hierarchical order in the acquisition of Korean stops. I suppose that further investigation of the acquisition of stops in all the other phonological domains is needed to follow Zampini's suggestion.

5. Results and Discussion

In this chapter, we will deal with data collected from the English- and Finnish-speaking subjects through the three tasks described in Chapter 4. An analysis of the data will reveal that the acquisition of segmental phonology involves phonological representations and rules and is not simply a matter of articulation. This will be unfolded by examining the data by means of the predictions for the L2A of Korean stops, which were stated in Chapter 3.

Results from each task were calculated into percentages. To give a clearer view over results in this study, results from each task are exclusively presented in figures in the beginning of sections 5.1, 5.2 and 5.4, and are followed by analyses of the data in discussion. Results from the auditory segmental discrimination task and the picture naming task are presented in three ways in sections 5.1 and 5.2: (1) individual results of the English- and Finnish-speaking subjects; (2) comparison of the English- and Finnish-speaking subjects' overall performance; and (3) comparison of the error types made by the English- and Finnish-speaking subjects. Section 5.3 discusses the dissociation of perception and production, which were revealed in results from the tasks of 'Segmental Discrimination' and 'Picture Naming'. Results from the task of 'Reading Compounds from Flash Cards' are presented in three separate parts under 'Tensification', 'Intervocalic Voicing' and 'Nonce Words' in section 5.4, focusing on individual results and comparison of the English- and Finnish-speaking subjects' overall performance. Tables containing the error classification are provided in Appendix 5.

5.1. Perception of Korean Stops (Segmental Discrimination)

5.1.1. Individual Results and Developmental Stages

Individual results of the English and Finnish subjects' perception are given in Tables 5.1.1 and 5.1.2. 'Aspirated', 'Plain' and 'Tense' on the top of the tables refer to the types of phonemes presented to the subjects as stimuli. The figures in each of the columns indicate the frequencies of mismatch (including the match with 'Not sure') with the given cue in the auditory task. Along with the raw numbers of errors, percentages correct of each subject have also been provided in tables. The percentages for each subject indicate his or her overall performance of correct responses to the 27 stimuli. Total raw numbers of misperceptions and percentages of misperceptions for each type of stops as well as mean percentages correct of the group are provided at the bottom of the tables. As a whole, results from both groups appear very similar to each other. The mean percentage correct of the English group is 67.52% within a range of 42.44% to 92.59% and that of the Finnish group is 62.72% within a range of 42.44% to 88.89%. Neither the English nor the Finnish groups show any apparent evidence that they make progress in the acquisition of Korean stops in accordance with the developmental stages; however, it is interesting that E-1 in 'Inexperienced I' scored the highest and F-13 in 'Experienced' scored the second lowest among all the English and the Finnish subjects. It should be also noted as impressive that E-2 in 'Inexperienced I' obtained the second highest score, while the next highest score in 'Inexperienced I' is scarcely over 60% and the others are all under 60% ranging from 42.44% to 59.26%.

Table 5.1.1. English speakers' performance on the auditory task (Total 351 tokens)

		Aspirated (9 tokens)	Plain (9 tokens)	Tense (9 tokens)	Total number of errors	Percentage correct (%)
Inexperienced I	E-1	0	2	0	2/27	92.59
	E-2	0	2	1	3/27	88.89
	E-3	4	5	1	10/27	62.96
	E-4	2	8	2	12/27	55.56
	E-5	7	6	2	15/27	42.44
Inexperienced II	E-6	2	4	1	7/27	74.07
	E-7	4	2	0	6/27	77.78
	E-8	3	6	4	13/27	51.85
	E-9	5	5	1	11/27	59.26
	E-10	4	4	2	10/27	62.96
Experienced	E-11	6	2	2	10/27	62.96
	E-12	0	4	2	6/27	77.78
	E-13	3	4	2	9/27	66.67
Number of Errors		40	54	20	114/351	
Means of Percentage correct		64.91%	52.63%	82.46%		**67.52%**

Table 5.1.2. Finnish speakers' performance on the auditory task (Total 405 tokens)

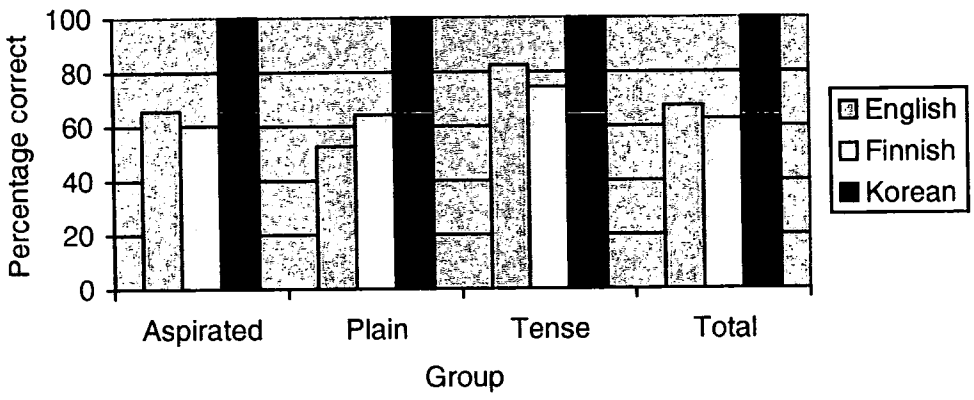
		Aspirated (9 tokens)	Plain (9 tokens)	Tense (9 tokens)	Total number of errors	Percentage correct (%)
Inexperienced I	F-1	7	6	2	15/27	42.44
	F-2	5	7	2	14/27	51.85
	F-3	5	2	4	11/27	59.26
	F-4	6	4	1	11/27	59.26
	F-5	5	5	4	14/27	51.85
Inexperienced II	F-6	4	3	0	7/27	74.07
	F-7	5	2	4	11/27	59.26
	F-8	6	1	4	11/27	59.26
	F-9	2	2	0	4/27	85.19
	F-10	3	3	4	10/27	62.96
Experienced	F-11	1	4	3	8/27	70.37
	F-12	0	2	1	3/27	88.89
	F-13	1	6	6	13/27	51.85
	F-14	4	3	1	8/27	70.37
	F-15	6	4	1	11/27	59.26
Number of Errors		60	54	37	151/405	
Means of Percentage Correct		60.26%	64.24%	74.50%		**62.72%**

5.1.2. Comparison of the Two Language Groups

In order to compare the English, Finnish and Korean groups' performance, the errors in each column of 'Aspirated', 'Plain' and 'Tense' were calculated into percentages, as illustrated in Figure 5.1.1. The Korean control subjects scored 100% for all the three types of stops, which, I assume, supports the validity of the test. The English subjects scored 64.91% and the Finnish subjects 60.26% for aspirated stops. Concerning the percentages correct, the two language groups appear to discern aspirated stops very similarly to each other despite the fact that the feature representations of English and Finnish stops are different from each other, as illustrated in Chapter 3. These figures need to be analysed further, and the details will be discussed in Section 5.1.4.

On the other hand, the English and Finnish subjects show differences in their performance for plain and tense stop stimuli. For plain stops, the Finnish subjects performed 64.24% correctly, which is similar to their performance for aspirated stops. The English subjects scored 52.63%, which is lower not only than the score gained by the Finnish subjects but also than their own score for aspirated stops. For tense stops, the English subjects scored 82.46%, and the Finnish subjects 74.50%. These scores are higher than those for the two other types of stops. The results for plain stops and tense stops will be also further discussed along with the analysis of misperception in Section 5.1.4.

Figure 5.1.1. Overall auditory performance by group



5.1.3. Comparison of Misperception Categories

Figure 5.1.2 and Table 5.1.3 demonstrate the comparison of the misperception types in percentage calculated out of the total number of misperceptions made by each group, and Figures 5.1.3-5.1.5 illustrate misperception types in percentage calculated out of numbers of misperception in identifying aspirated, plain and tense stops, respectively.

Starting with Figure 5.1.3, 'Errors in identifying aspirated stops', both the English- and Finnish-speaking subjects tend to misperceive aspirated stops as plain stops (77.5% for English and 80% for Finnish) but not as tense stops. There was only one error of misperceiving the aspirated stop as the tense stop, and the rest of the items of misperception were marked as 'Not sure'.

Figure 5.1.2. Comparison of misperception categories

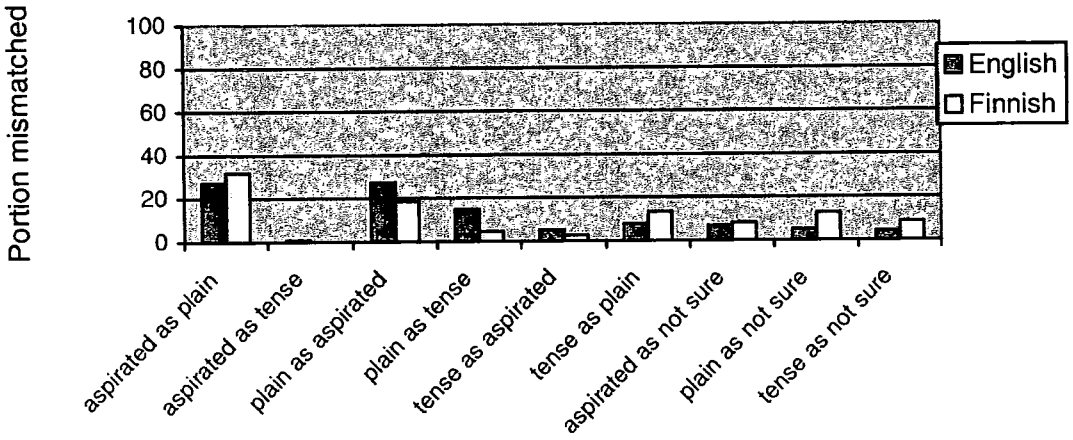


Table 5.1.3. Comparison of misperception types out of total errors made by each group (%)

	Aspirated		Plain		Tense		Not sure	
	Eng	Finn	Eng	Finn	Eng	Finn	Eng	Finn
Aspirated	--	--	27.19	31.79	0.88	0	7.02	7.95
Plain	27.19	18.54	--	--	14.91	4.64	5.26	12.58
Tense	5.26	2.65	7.89	13.25	--	--	4.39	8.61

*Note: 'Aspirated', 'Plain' and 'Tense' on the leftmost column refers to the types of stops given as stimuli, and 'Aspirated', 'Plain', 'Tense' and 'Not sure' on the top row indicate the options to respond to the stimuli.

*Glossary: Eng - the English subjects, Finn - the Finnish subjects

For the discrimination between aspirated stops and plain stops, English-speaking subjects misperceived aspirated stops as plain stops as frequently as 77.5% out of the misperceptions and marked 'Not sure' as frequently as 20% of the misperceptions while Finnish-speaking subjects misperceived aspirated stops as plain stops as frequently as 80% of the misperceptions and marked 'Not sure' as frequently as 20% of the misperceptions. In identifying plain stops (See Figure 5.1.4), English-speaking subjects misperceived plain stops as aspirated stops 57.41% of the time and as tense stops 31.48% of the time, and they marked 'Not sure' 11.11% of the time whereas Finnish-speaking subjects misperceived plain stops as aspirated stops 51.85% of the time and as tense stops 12.96% of the time, and marked 'Not sure' 35.19% of the time. As for identifying tense stops (See Figure 5.1.5), English- and Finnish-speaking subjects made errors 30% and 10.81% of the time by misperceiving tense stops as aspirated stops, 45% and 54.05% of the time by misperceiving tense stops as plain stops, and 25% and 35.14% of the time by marking 'Not sure', respectively.

Figure 5.1.3. Errors in identifying aspirated stops

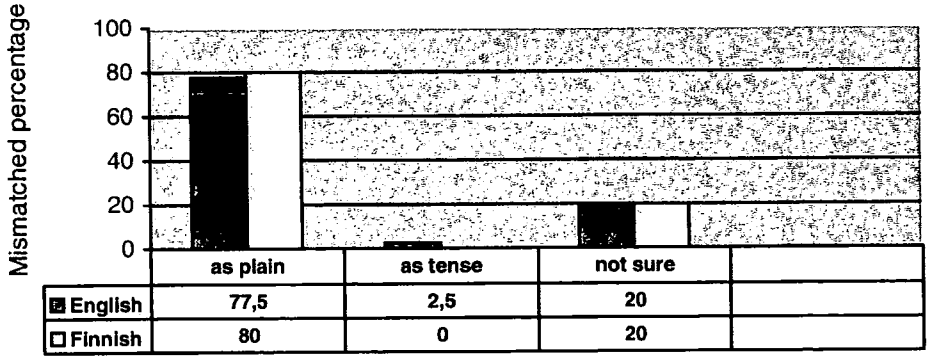


Figure 5.1.4. Errors in identifying plain stops

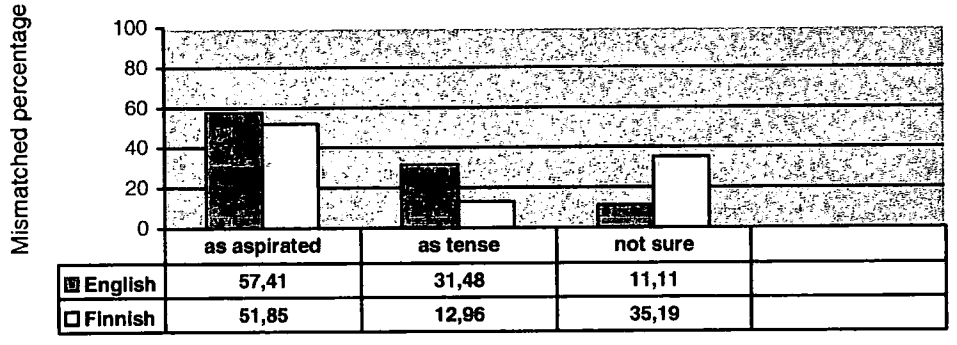
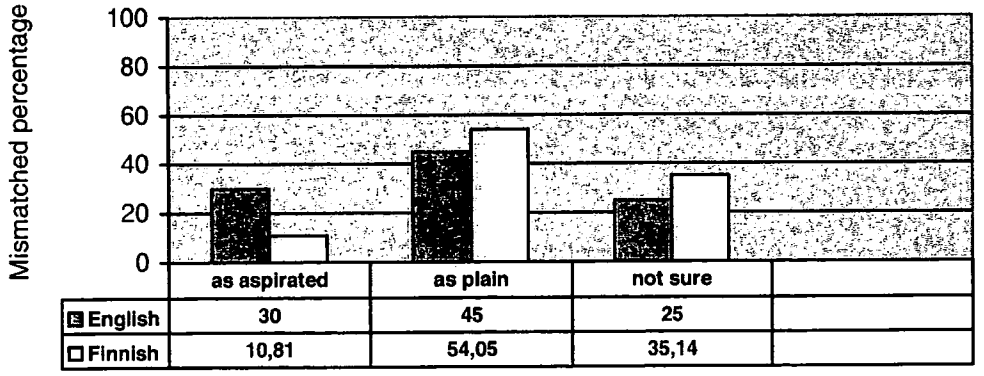


Figure 5.1.5. Errors in identifying tense stops



5.1.4. Discussion

Let us first look at the most successful discrimination between aspirated stops and tense stops as shown in Figure 5.1.3, 'Errors in identifying aspirated stops'. In oppositon to EP1 and FP1, predictions suggested in Section 3.5, Chapter 3, there was only one error of misperceiving the aspirated stop as a tense stop. This phenomenon implies that 20% of 'Not sure' may have been caused by the confusion between aspirated stops and plain stops rather than between aspirated stops and tense stops. In other words, the two groups of subjects were (almost) able to make a native-like distinction between aspirated stops and tense stops when aspirated stops were given as stimuli. Thus, I presume that 'Not sure' in identifying aspirated stops is a grey area only between aspirated and plain stops but not between aspirated and tense stops for English and Finnish speakers. As neither a distinction between aspirated and plain stops nor between aspirated and tense stops exists in native English or Finnish speakers, this may be regarded as not supporting Brown's (1998, 2000) studies which posited that only those features represented in the learner's L1 result in perceptual sensitivity to particular non-native contrasts in L2A. However, I suggest that the acquisition of phonemes should involve the elements on the skeletal tier as well as features of the target phoneme. In Korean, aspirated and plain stops are distinguished by the feature [sg], but the distinction for tense stops with double-timing slots is beyond the matter of features and needs to be considered in terms of timing units on the skeletal tier, too. Consideration of the suprasegmental level (e.g. the position in a syllable, etc.) could help explain why Brown's (1998) Japanese subjects in all developmental levels were native-like at the /l-r/ distinction in the coda position.[19]

[19] For the /l-r/ distinction, the 10 Japanese subjects in Brown (1998) performed 99.3% correctly in the coda position, 31.1% correctly in the onset position and 38.1% correctly in the cluster conditions.

Hence, I assume that the clear distinction between Korean aspirated and tense stops in English and Finnish learners' minds is not simply a matter of feature acquisition but also related to another factor such as the timing unit. Still, we must keep it in mind that the overall percentages correct for aspirated stops (as stimuli) stand at 64.91% for the English subjects and 60.26% for the Finnish subjects; that is, the distinction for aspirated stops is not clear to them; English and Finnish speakers are not very successful in discriminating between Korean aspirated and plain stops.

Now, we turn to the error types when tense stops were presented as stimuli (See Figure 5.1.5). Is the L2 learners' performance consistent with the above remarks suggesting the consideration of a prosodic or suprasegmental factor in the segmental structure? If they are, their performance should reach nearly 100% correct because tense stops are double-timing slotted whereas aspirated and plain stops are single-timing slotted. Results show that English subjects accurately performed 82.46% and Finnish subjects 74.50%. Although the figures are lower than predicted, they are still higher than when aspirated stops or plain stops were presented as stimuli. In other words, English and Finnish speakers may find it easier to discern a tense stop with double-timing slots from an aspirated or plain stop with a single-timing slot than other sorts of Korean stop discriminations. At this point, let us recall the discussion in Section 3.1.3.1 of Chapter 3 that tense stops are geminates of plain stops, not of aspirated stops. Grounded on this fact, I predict that the discrimination between tense stops (as stimuli) and plain stops should not be as successful as the discrimination between tense stops (as stimuli) and aspirated stops for L2 learners of Korean. For instance, suppose that we have AA standing for a geminate of A and B as a third segment. It might be even easier to discern

AA from B than from A. In addition, it is possible for L2 learners to be influenced by presence or absence of their knowledge of geminates in their L1. However, I do not mean that existence of L1 knowledge of geminates must help L2 learners to learn geminates in the target language better. Remember that the English-speaking subjects who lack geminates in their L1 were also native-like for the discrimination between aspirated stops and tense stops. I presume that L1 grammar regarding geminates will play a certain role in L2A of Korean stops whether it is positive or negative. Then, with regard to this presumption, let us examine the English- and the Finnish-speaking subjects' error types in the performance for the tense stop discrimination so that we may find how L1 knowledge of geminates affects the L2 learners' acquisition of Korean geminate sounds (i.e. tense stops).

In this case, supporting EP1, English speakers who lack geminates in their L1 did not show apparent differences among the types of misperception (i.e. 'tense as aspirated', tense as plain' and 'tense as *not sure*'). Within the incorrect responses of 20 errors in discerning tense stops from others, the percentages of mismatches to 'Aspirated', to 'Plain' and to 'Not sure' were 30%, 45% and 25%, respectively. These percentages have come to 5.25%, 7.89% and 4.39%, respectively among the total number of 114 errors. The figures imply that they do not discriminate between the two single-slotted segments, aspirated and plain stops. If they had differentiated the two types of single-timing slotted Korean stops from each other, they would have shown a certain preference by selecting either of them more frequently rather than marking the three incorrect options (i.e. 'Aspirated', 'Plain' and 'Not sure') evenly. However, they did not reveal a particular tendency for a certain type of stop at all. Thus, it is likely that the English-speaking

subjects are unable to successfully distinguish non-geminate stops from each other although they can distinguish stop geminates from non-geminate stops in word-initial position, by showing the higher percentage correct for the tense stop discrimination. Considering that the Korean stop geminates are unaspirated, this finding echoes cross-language speech perception research which has shown that English speakers distinguish synthetic voice onset time counterparts of aspirated-unaspirated minimal pairs more readily than voiced-voiceless (Keating, Linker and Huffman 1983). This may be also explained in terms of the contrast of geminate vs. non-geminate or the number of the timing slots in segmental structure. English speakers could find it easier to perceive the distinction of aspirated-unaspirated contrasts by means of the timing unit than the distinction of voiced-voiceless contrasts which is not made by the timing unit of the segment but the feature [voice]. Hence, although the aspirated-unaspirated contrast is not found in their L1, they are able to discriminate the aspirated from the unaspirated better than the voiced from the voiceless.

Now, we analyse the Finnish subjects' performance in identifying tense stops. Finnish allows geminates in the word-medial position but never in the word-initial position. Owing to their knowledge about the position of geminates in a word, Finnish speakers, as FP1 predicted, may be confused between tense stops and plain stops. That is, when Finnish speakers hear Korean tense stops in the word-initial position, their L1 grammar could influence them to misjudge the tense stops as plain stops rather than aspirated stops. Their sensitivity to geminate sounds may lead them to acknowledge AA (tense stops) as A (plain stops) as in Finnish whilst English speakers unfamiliar with geminates have no preference for either A or B. Therefore, the Finnish speakers

confusion between AA and A will lead them to mark 'Plain' relatively more frequently than 'Aspirated'. In addition, I suppose that this confusion could lead the Finnish subjects to mark 'Not sure' more often than the English subjects. Looking at the figures, the percentages of mismatches to 'Aspirated', to 'Plain' and to 'Not sure' were 10.81%, 54.05% and 35.14% respectively out of the incorrect responses of 29 errors in discerning tense stops from the others. These percentages come to 2.65%, 13.25% and 8.61%, respectively, among the total number of 151 errors. Unlike the English subjects, the mismatch percentages of the error types in the Finnish speakers' tense identification performance are not even. The mismatch percentage for 'Plain' is the highest and the mismatch percentage for 'Aspirated' the lowest. Thus, the figures show that the learner's knowledge about geminate affects error types.

Based on the analysis of error types given so far, the following is expected regarding errors in identifying plain stops (See Figure 5.1.4). Firstly, both Finnish and English speakers will be better in discerning plain stops from tense stops than in discerning them from aspirated stops. Secondly, Finnish speakers may have more of a tendency to mismatch word-initial plain stops with aspirated stops than tense stops because they have the knowledge that geminates are forbidden in the word-initial position. Still, Finnish speakers may detect the difference between a plain stop with a single-timing slot and a tense stop with double-timing slots, as Finnish has geminates although not in the word-initial position. The gap between this detection and their L1 knowledge about geminates could lead them to respond to mark 'Not sure' more frequently than English speakers. Lastly, it is expected that the distinction between plain stops and tense stops may not be as clear as that between aspirated stops and tense stops

to both English and Finnish speakers. This is due to the fact that a tense segment in Korean is assumed to have two plain segments at the skeletal tier of the segment structure. Accordingly, it is presumed that L2 learners of Korean are more successful to discriminate a double-timing slotted segment (i.e. tense stops) from a different type of a single-timing slotted segment (i.e. aspirated stops), rather than from the same single-timing slotted segment as in the geminate (i.e. plain stops). Although not as perfect as for the distinction of aspirated stops from tense stops, English and Finnish speakers must be better in discerning plain stops from tense stops than in discerning two single-timing slotted segments from each other.

The English subjects' data show us that out of 54 misperceptions in discerning plain stops from others, the percentages of their misperception as 'Aspirated', as 'Tense' and as 'Not sure' were 57.41%, 31.48% and 11.11%, respectively. These percentages are 27.19%, 14.91% and 5.26%, respectively among the total number of 114 misperceptions. On the other hand, the Finnish subjects' data show us that out of the incorrect responses of 54 errors in discerning plain stops from others, the percentages of misperception as 'Aspirated', as 'Tense' and as 'Not sure' were 51.85%, 12.96% and 35.19% respectively. These percentages have come to 18.54%, 4.64% and 12.58% respectively among the total number of 151 misperceptions. In identifying stimuli plain stops, the English subjects discriminated them from tense stops better than from aspirated stops by 15.93%, and the Finnish speakers by 38.89%. By these figures was the first prediction supported, and the figure 38.89%, the gap made by the Finnish speakers specifically supports the second prediction. The figure 35.19% for 'Not sure' made by the Finnish subjects is larger than the English subjects' figure 11.11% for 'Not sure', which supports the hypothesis that

Finnish speakers may be more confused than English speakers in discerning the word-initial plain stops because of the two contradictory facts in Finnish speakers' mind. In summary, although both the English and the Finnish subjects demonstrated lower figures for the discrimination between plain stops and tense stops than for the discrimination between two single-timing slotted segments (i.e. plain stops from aspirated stops), the figures of these error types are still higher than those in the error types of the discrimination between aspirated stops and tense stops. Consequently, I conclude that it is easier to discern AA (tense stops) from B (aspirated stops distinguished from AA by the timing unit as well as by the distinctive feature [sg] than from A (plain stops distinguished solely by the timing unit).

5.1.5. Summary

I attempted to provide the reason for the perception difficulty in L2A of Korean stops through a phonological approach, departing from the examination of VOT measurements. The findings regarding the relation between L2A of Korean stops and the Korean specific distinctive feature [sg] have partly supported EP1 and FP1, which predicted that English and Finnish L2 learners of Korean would be confused among the three distinctive types of Korean stops (i.e. aspirated, plain and tense) because their L1 grammars lack the feature [spread glottis] and double-timing slots (XX) in the word-initial position. The L2 learners attained almost native-like proficiency in distinction between aspirated and tense stops despite the lack of the distinctive feature and double-timing slots in their L1s; however, they seemed confused in distinction between other types of stops. It was found that L2 learners distinguish the phoneme contrast caused by

the timing unit (i.e. geminate vs. non-geminate) more successfully than the phoneme contrast caused by the distinctive feature. This finding suggests that phonemic acquisition is not limited to the matter of acquisition of features alone of a phoneme but should be investigated beyond the level of features. As for the developmental factor, neither English- nor Finnish-speaking learners showed improvement in acquisition of Korean stops over time, as P4 predicted in Section 3.5, Chapter 3.

In conclusion, following are discoveries from the task of segmental discrimination: (i) The English and the Finnish subjects performed better in discerning geminates from non-geminate segment in general. Especially, the two language groups of subjects were native-like in discerning a geminate (AA) from a non-geminate of which segment is different from the ones in the geminate (B). On the other hand, the Korean stops distinguished by the feature [sg] alone have appeared to be the most difficult for the L2 learners of Korean to acquire. (ii) It is likely that English and Finnish speakers show a similar pattern of difficulties in discerning Korean stops regarding the feature [sg]; however, differences between the two language groups were also found in the acquisition of Korean stops. According to this present study, the different patterns of error types are caused by the absence or presence of the geminate in the learner's L1.

5.2. Production of Korean Stops (Picture Naming)

In the previous section, the perception of Korean stops by English and Finnish speakers was investigated. This section deals with the production of Korean stops by the same research subjects who participated in the perception task. The perception of Korean stops by the L2 learners were examined with phonological representations in mind,

focusing on the distinctive feature and timing unit (X) on the skeletal tier. In this section, not only phonological representations but also laryngeal processes and voice onset time (VOT) values of stops are employed to investigate the production of Korean stops. This is because production is not a passive process in language acquisition although perception may be regarded as such and involves physical aspects, too, unlike perception. There can be various physical factors affecting L2 production; however, laryngeal processes and VOT value, which have been most commonly looked at in the studies of stop sounds, are considered to make comparison with phonological representations in mind to look at the adult L2A of Korean stops. By doing this, we will be able to see if physical matters are more influential to L2 production or if mental representations are; in other words, if the difficulty of L2 pronunciation is caused more likely by articulatory problems (physical matters) or by phonological rules and principles (mental representations). Furthermore, how they affect the L2 production of Korean stops will be discussed if phonological representations appear to affect L2A by looking at results of the present experiment.

5.2.1. Individual Results and Developmental Stages

Individual results of the English- and Finnish-speaking subjects are provided in Tables 5.2.1 and 5.2.2. 'Aspirated', 'Plain' and 'Tense' on the top of the tables refer to the types of phonemes for the target pronunciation. The numbers in each of the columns are raw numbers of errors judged as other than the target pronunciation. The percentage correct for each subject has also been provided on the most right hand side in the tables. The percentage of each subject indicates his or her performance for correct production out of the 27 word-initial Korean stops provided in the picture naming task. Total raw

numbers of errors and percentages of errors for each type of stops as well as mean percentages correct of each group are provided at the bottom of the tables.

In Tables 5.2.1 and 5.2.2, results from the two language groups as a whole appear similar to each other. The mean percentage correct of the English-speaking group is 81.77% within a range of 51.85% to 96.30%, and that of the Finnish-speaking group is 87.30% within a range of 51.85% to 100%. Both the English- and the Finnish-speaking groups show the progress in producing the target pronunciation of Korean stops in accordance with the developmental stages. The subgroups of 'Inexperienced I', 'Inexperienced II' and 'Experienced' in the English-speaking group illustrate 74.01%, 80.74% and 96.30%, respectively for the percentage correct and those of in the Finnish-speaking group 74.82%, 93.33% and 95.37%, respectively. It should be noted that F-11, one of the Finnish learners in the group of 'Experienced' was not included in the 95.37% (the figure for the mean percentage correct of the Finnish 'Experienced' group), although her individual data are presented in the tables. (See Section 4.1, Chapter 4 for the reason.)

Table 5.2.1. English speakers' performance on the production task (Total 351 tokens)

		Aspirated (9 tokens)	Plain (9 tokens)	Tense (9 tokens)	Total number of errors	Percentage correct (%)
Inexperienced I	E-1	0	0	6	6/27	77.78
	E-2	0	1	4	5/27	81.48
	E-3	0	0	5	5/27	81.48
	E-4	4	3	6	13/27	51.85
	E-5	2	0	4	6/27	77.78
Inexperienced II	E-6	5	0	3	8/27	70.37
	E-7	2	0	3	5/27	81.48
	E-8	1	0	7	8/27	70.37
	E-9	0	0	1	1/27	96.30
	E-10	1	1	2	4/27	85.19
Experienced	E-11	1	0	0	1/27	96.30
	E-12	0	0	1	1/27	96.30
	E-13	0	0	1	1/27	96.30
Number of Errors		16	5	43	64/351	
Means of Percentage Correct		86.32%	95.73%	63.25%		**81.77%**

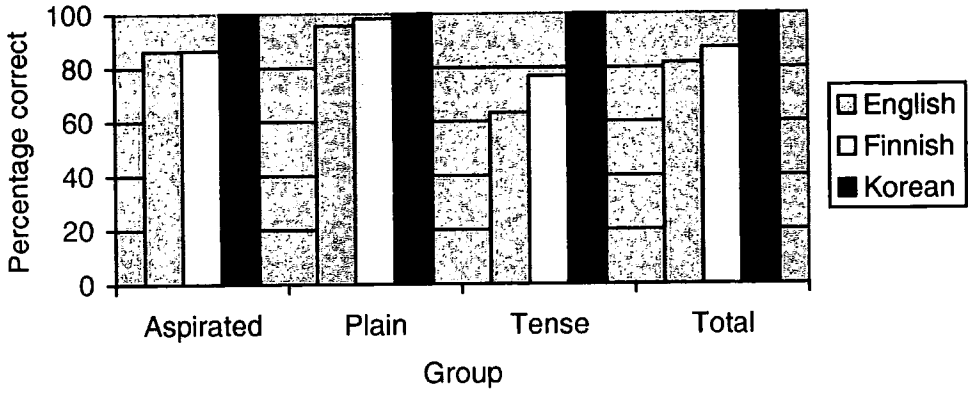
Table 5.2.2. Finnish speakers' performance on the production task (Total 378 tokens)

		Aspirated (9 tokens)	Plain (9 tokens)	Tense (9 tokens)	Total number of errors	Percentage correct (%)
Inexperienced I	F-1	0	0	9	9/27	66.67
	F-2	6	1	6	13/27	51.85
	F-3	1	0	3	4/27	85.19
	F-4	3	0	2	5/27	81.48
	F-5	0	0	3	3/27	88.89
Inexperienced II	F-6	2	0	0	2/27	92.59
	F-7	2	0	0	2/27	92.59
	F-8	0	0	3	3/27	88.89
	F-9	2	0	0	2/27	92.59
	F-10	0	0	0	0/27	100
Experienced	F-11	6	4	0	10/27	62.96
	F-12	0	0	0	0/27	100
	F-13	1	0	2	3/27	88.89
	F-14	0	0	1	1/27	96.30
	F-15	0	1	0	1/27	96.30
Number of Errors		17	2	29	48/378	
Means of Percentage Correct		86.51%	98.41%	76.98%		**87.30%**

5.2.2. Comparison of the Two Language Groups

The English-, Finnish- and Korean-speaking groups' production performances are illustrated in Figure 5.2.1. The Korean control subjects scored 100% for all the three types of stops, supporting the reliability of the testing instrument. The English-speaking subjects scored 86.32% and the Finnish-speaking subjects 86.51% for aspirated stops. Concerning the percentages correct, the English- and Finnish-speaking groups appear almost equally successful in producing aspirated stops regardless of the fact that Finnish does not have any aspirated stops whereas English does; hence, these figures will be discussed further in the following section. For plain stops, the English- and Finnish-speaking groups also show very close figures of percentages to each other. Plain stops produced by the English- and Finnish-speaking subjects were judged as correct 95.73% of the time and 98.41% of the time, respectively by the native Korean judge. However, the English- and Finnish-speaking subjects show a relatively bigger gap for tense stops. The English-speaking subjects scored 63.25% and the Finnish-speaking subjects 76.98%.

Figure 5.2.1. Overall production by group



The figures of the percentages correct so far show that both language groups performed the most successfully for plain stops and the most poorly for tense stops; this will be discussed further with the analysis of error types in the next section.

5.2.3. Comparison of the Error Types

Figures 5.2.3 - 5.2.5 demonstrate error patterns by visualising error rates for the types of mispronounced stops in production of aspirated, plain and tense stops, respectively. Figure 5.2.2 and Table 5.2.3, on the other hand, demonstrate the percentages of each error type which was calculated out of the total number of errors made by each group. A number of factors may play a role in forming a certain error pattern; however, we will look at the error types in this section in consideration of the VOT values and articulatory manner as well as phonological representations of stops in the three languages.

Figure 5.2.2. Comparison of error types

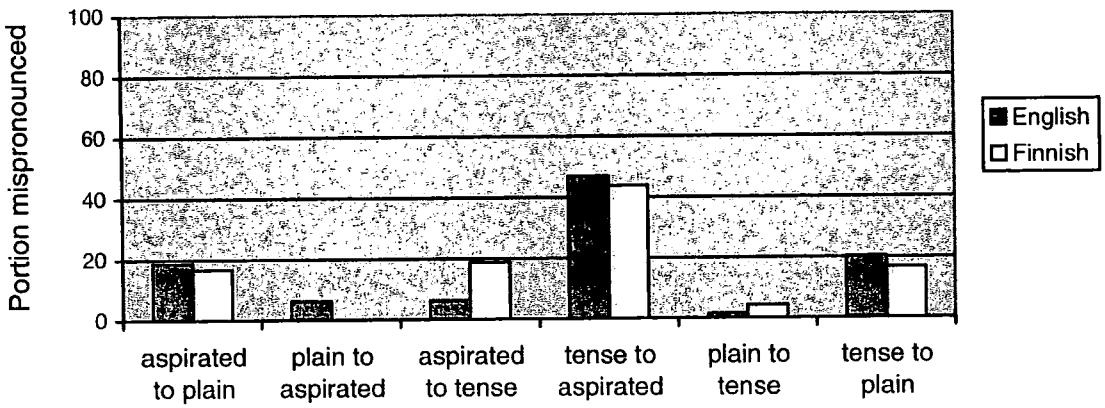


Table 5.2.3. Comparison of error types out of total errors made by each group (%)

	Aspirated		Plain		Tense	
	Eng	Finn	Eng	Finn	Eng	Finn
Aspirated	--	--	18.75	16.67	6.25	18.75
Plain	6.25	0	--	--	1.56	4.17
Tense	46.88	43.75	20.31	16.67	--	--

*Note: 'Aspirated', 'Plain' and 'Tense' on the leftmost column refers to the target types of Korean stops, and Aspirated', 'Plain' and 'Tense' on the top row indicate the types of errors.
*Glossary: Eng - the English-speaking subjects, Finn - the Finnish-speaking subjects

Figure 5.2.3. Errors in producing aspirated stops

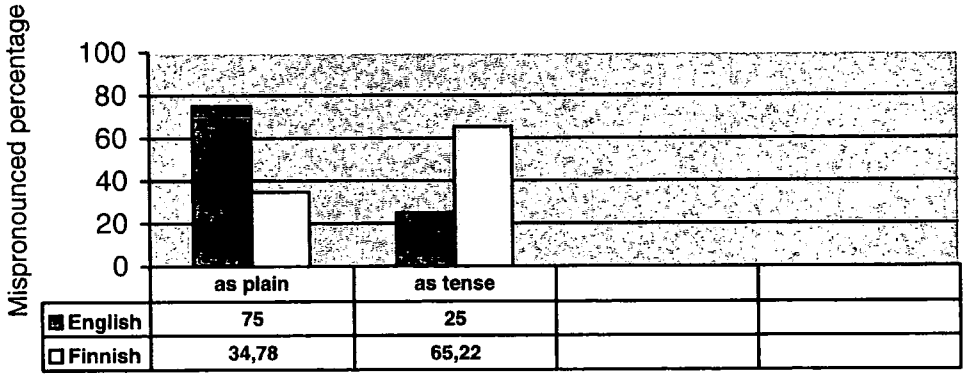


Figure 5.2.4. Errors in producing plain stops

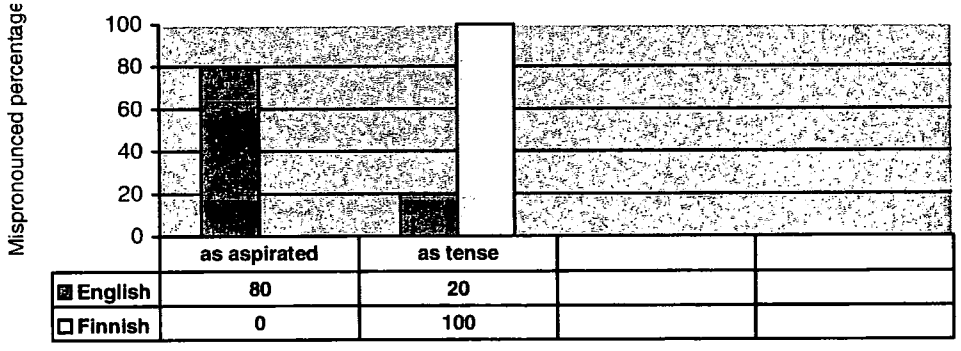
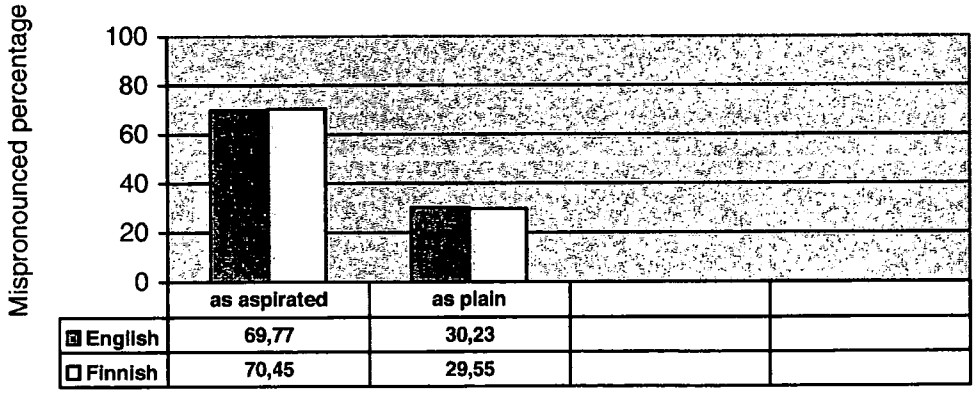


Figure 5.2.5. Errors in producing tense stops



According to the results illustrated in Figure 5.2.3, 'Errors in producing aspirated stops', the English-speaking subjects tend to produce aspirated stops as plain stops rather than as tense stops whereas the Finnish-speaking subjects show the opposite tendency. For the English-speaking subjects, out of 13.68% (the percentage of errors for production of aspirated stops in Table 5.2.1), 75% of the time was judged as plain stops and 25% of the time as tense stops by the native Korean judge. On the other hand, for the Finnish-speaking subjects, the native Korean judge judged 34.78% of the time as plain stops and 65.22% of the time as tense stops out of 13.49% (the percentage of errors for production of aspirated stops in Table 5.2.2.).

Now, we turn to Figure 5.2.4, 'Errors in producing plain stops'. Only five (4.27%) out of 117 tokens produced by the English subjects were judged as non- Korean aspirated stops by the native Korean judge. Four (80%) out of the five errors were identified as aspirated stops and one (20%) as a tense stop by the judge. On the contrary, six errors (1.59%) out of 126 tokens made by Finnish subjects were identified as tense stops by the judge. At this point, one might raise questions such as; 'What caused the English- and Finnish-speaking subjects to shape the error patterns in production of aspirated and plain stops in the opposite direction to each other?' and 'why did both English- and Finnish-speaking subjects perform better for plain stops than aspirated stops?' These questions will be discussed with regard to the degree of VOT values in the following section.

Then, we move on to Figure 5.2.5, 'Errors in producing tense stops'. Finnish [p, t, k] in the word-initial position appear almost identical to Korean [p', t', k'] with regard to laryngeal processes; they are both characterised as unaspirated voiceless. This implies

that Finnish-speaking subjects should have performed successfully for the production of tense stops. However, they performed 76.98% of the time correctly out of 126 trials, which is the lowest score among the three error types. English-speaking subjects also scored the lowest for the production of tense stops by 63.25% of 117 trials. In this case, why did positive L1 transfer not occur in the tense stop production by the Finnish-speaking subjects? In addition, why did both English- and Finnish-speaking subjects more frequently produce aspirated stops in the place of tense stops than plain stops? I attempt to answer to these questions in the following section as well.

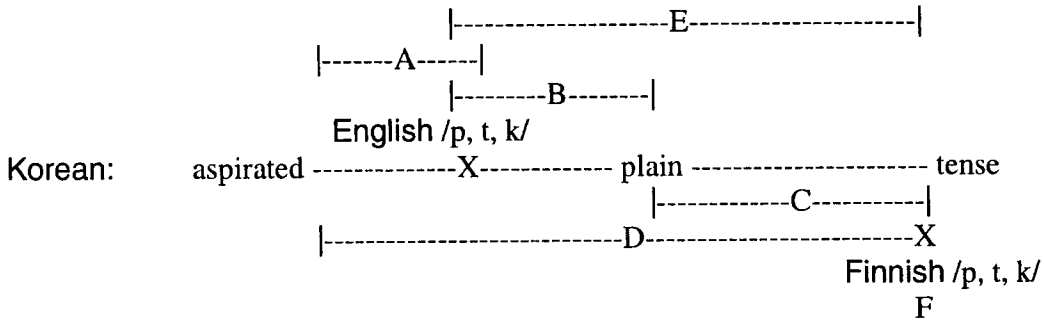
5.2.4. Discussion

This section deals with the questions raised in the previous section. First, we look at the questions regarding error patterns in production of aspirated and plain stops.

- What caused the English- and Finnish-speaking subjects to shape the error patterns for production of aspirated and plain stops in the opposite direction of each other? And why did both English- and Finnish-speaking subjects perform better for plain stops than aspirated stops?

Now, we have to consider the inferences mentioned earlier in Section 2.2 of Chapter 2; (i) VOT values produced by adult L2 learners may remain intermediate to the phonetic norm for VOT in L1 and L2, and (ii) the intermediate VOT values produced by adult L2 learners may be closer to their L1's than to the L2's. I assume that the English- and Finnish-speaking subjects could have also produced the Korean stops with the intermediate VOT values between the L1 and

(5.1) Assumed ranges of VOT values produced by the L2 learners of Korean



A. The assumed range of VOT values for aspirated stops produced by the English-speaking subjects
B. The assumed range of VOT values for plain stops produced by the English-speaking subjects
C. The assumed range of VOT values for plain stops produced by the Finnish-speaking subjects
D. The assumed range of VOT values for aspirated stops produced by the Finnish-speaking subjects
E. The assumed range of VOT values for tense stops produced by the English-speaking subjects
F. The assumed range of VOT values for tense stops produced by the Finnish-speaking subjects
X. The actual locations of VOT values of English voiceless and Finnish unaspirated voiceless stops respectively

L2 stops like the L2 subjects in the previous studies. I attempt to unravel the first question by exploiting the model given in (5.1), in which assumed VOT ranges of the English- and Finnish-speaking subjects' Korean stop production are marked. As illustrated in (5.1), the VOT values for aspirated and plain stops produced by the English-speaking subjects are expected to fall on the ranges of A and B respectively on the VOT continuum. Stops produced by English speakers on the range of B may be mainly heard as plain stops by native Korean speakers. Still, the VOT values on the range of A, unless the English learners produce aspirated stops with higher VOT values, can be also

frequently identified as plain stops. It is, therefore, supposed that English speakers may score for production of plain stops more successfully than aspirated stops when judged by a native Korean speaker. As predicted, errors in production of aspirated stops occurred more frequently than those in production of plain stops (See the English-speaking subjects' performance in Figures 5.2.3 and 5.2.4). Sixteen and five errors out of 117 tokens were made in production of aspirated and plain stops respectively. Likewise, (5.1) implies that English speakers would not make errors by producing tense stops for aspirated or plain stops, on the contrary to which there were errors of producing tense stops in the place of aspirated or plain stops although the rates are very low (i.e. four (6.25%) and one (1.56%) out of 117 tokens for production of aspirated and plain stops respectively). But it needs to be noted that the four errors in production of aspirated stops were made by only one subject.

As for the Finnish-speaking subjects, it is expected that their VOT values for aspirated stops would fall on the range of D and those for Korean plain stops on the range of C. The Finnish-speaking subjects are naturally expected to more frequently make errors by producing tense stops than the other types of Korean stops; this is supported by the error rates demonstrated in Figures 5.2.3 and 5.2.4. For the production of plain stops, we can presume, by looking at the assumed ranges of VOT values in (5.1), that Finnish speakers are to make errors by producing tense stops more frequently rather than aspirated stops. It is noteworthy that no aspirated stops were produced as errors by the Finnish-speaking subjects. In fact, there may be no chance for them to make errors by producing aspirated stops for plain stops on the range of C. On the range of D, however, there are possibilities that Finnish speakers make errors by producing both plain and tense

stops for the production of aspirated stops although they are expected to more frequently make errors by producing tense stops than plain stops owing to their L1 influence of the VOT values. In summary, the error rates conform to the inferences: They produced plain stops 34.78% of the time and tense stops 65.22% of the time in replacement of aspirated stops, and their errors in production of plain stops were all identified as tense stops 100% of the time (See the Finnish-speaking subjects' performance in Figures 5.2.3 and 5.2.4).

Yet, this analysis in the notion of VOT values does not explain the English- and Finnish-speaking subjects' performance for tense stops. If the same analysis were applied to the L2 learners' error patterns for the production of tense stops, the English-speaking subjects' errors must have been more frequently heard as plain stops, and the Finnish-speaking subjects are expected to perform perfectly to produce Korean tense stops owing to their L1 transfer. The results in Figure 5.2.5, however, are very different from the assumptions (E and F) mentioned in (5.1). Hence, I put forward the next question in order to discuss the problem caused in the analysis using VOT measurements alone.

- Why did positive L1 transfer not occur in the tense stop production by the Finnish-speaking subjects? Moreover, why did both English- and Finnish-speaking subjects more frequently produce aspirated stops in the place of tense stops than plain stops?

In the production of tense stops, aspirated stops were produced 69.77% of the time and plain stops 30.23% of the time out of 36.75% (the percentage of errors for

production of tense stops in Table 5.2.1) by English-speaking subjects. The Finnish-speaking subjects produced the aspirated 70.45% of the time and the plain 29.55% of the time out of 23.02% (the percentage of errors for production of tense stops in Table 5.2.2), which look almost identical to the English-speaking subjects'. In order to provide an explanation for this phenomenon, we need be reminded of the phonological representations of English, Finnish and Korean stops.

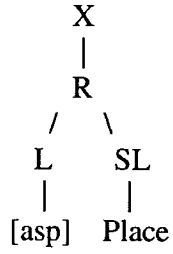
As we see the phonological representations in (5.2), the Korean tense stops occupy two timing slots unlike English and Finnish stops. I assume that this particular Korean aspect made it difficult for both groups of subjects to succeed in acquiring the production of tense stops. Since Korean aspirated and tense stops are articulatorily and acoustically tensed, both of the two groups could have tended to replace tense stops with aspirated stops more frequently than with plain stops. Then, although the L2 subjects showed having difficulty in producing Korean tense stops through the experiment, should the errors produced as tense stops by Finnish-speaking subjects in the two previous cases (i.e. 'errors in producing aspirated stops' and 'errors in producing plain stops') be viewed as genuine Korean tense stops with two-timing slots? I avoid exploring this issue which may be a matter beyond investigation.[20] However, the native Korean judge must have classified errors of tense stops depending on the categorical perception of VOT values and laryngeal processes (probably as well as the phonological representation). Therefore, even if the L2 subjects produced single-timing unaspirated voiceless stops, they could have been heard as tense stops by the native Korean judge.

[20] As far as I know, there have been no studies reporting that the difference between single-timing slotted stops and two-timing slotted stops can be captured by any means.

(5.2) Phonological representations of English, Finnish and Korean stops

a. Distinction between voiceless and voiced stops in English

a. /p, t, k/

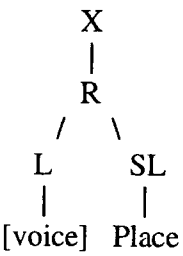


b. /b, d, g/

b. Distinction between voiceless and voiced stops in Finnish

a. /p, t, k/

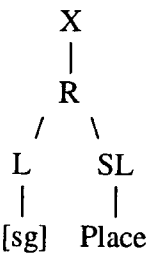
b. /b, d, g/



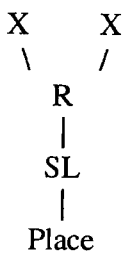
c. Three ways of distinctions of Korean stops

a. /p, t, k/

b. /p^h, t^h, k^h/



c. /p', t', k'/



In short, English- and Finnish-speaking subjects seem to be challenged by the same problem of producing stops with two-timing slots. Although the two groups of L2 subjects showed differences in the production of single-timing slotted stops (i.e. aspirated and plain stops), they performed almost identically for tense stops when facing the common challenge of producing two-timing slotted stops.

5.2.5. Summary

So far, we have examined the L2 production of Korean stops by English and Finnish speakers in light of manner of articulation, VOT values and phonological representation. How the three factors affect the L2A of Korean stops is summarized one by one below.

Manner of articulation (Laryngeal processes): According to Flege and Port (1981), which compares phonetic implementation of the stops voicing contrast (/p-b/, /t-d/ and /k-g/) produced in Arabic by Saudi Arabians and by both Americans and Saudis in English, their L2 learners grasped the phonological nature of a given segment but were unable to control all the articulatory dimensions by which the sounds are produced. Regarding tense stops, the L2 subjects in the present study seem to have same sort of difficulty (i.e. controlling the articulation of Korean stops) as the subjects in Flege & Port (1981) did, although they recognise the phonological differences between their L1 stops and Korean stops.

VOT values: The L2 data from the task of picture naming, which were judged by a native Korean speaker, agree with Flege (1987), Flege & Eefting (1987) and Flege & Port (1981). Flege (1987) reported that VOT values produced by adult L2 learners might

be intermediate to the phonetic norm for VOT in L1 and L2. The intermediate VOT values produced by adult L2 learners might be closer to their L1s than to the L2's (Flege & Eefting 1987, Flege & Port 1981). However, the L2 Korean stops judged as correct could have been produced with authentic VOT values to be native-like, considering Major (1987), in which some Brazilian Portuguese learners of English achieved native-like VOT proficiency in production of the word-initial /p, t, k/; consequently, it was suggested by Major that VOT values are within the grasp of L2 learners and that it is possible for even adult L2 learners to achieve native-like VOT proficiency.

Phonological representations: L2-particular phonological representations on the prosodic level (i.e. the skeletal tier) may play a role in making it more difficult to attain the native-like pronunciation of L2 stops than controlling the degree of VOT (Hannahs & Young-Scholten 1997). Otherwise, the Finnish-speaking subjects would have been highly successful in the production of Korean tense stops which are pronounced in the similar manner of articulation and with the similar VOT values as their L1 unaspirated voiceless stops.

Overall, production of the three types of Korean stops by both English- and Finnish-speaking learners was very successful, contrary to EP1 and FP1. In order to examine the production of word-initial Korean stops, manner of articulation and VOT values as well as phonological representations were accounted for, and it seems that error patterns were formed according to judgement of the native Korean-speaking judge who categorically perceives stop sounds. However, in the case of the tense stop production, it is likely that errors occurred owing to the lack of the unique phonological representation of the Korean tense stop in the learner's mind. Regarding the developmental factor, both

English- and Finnish-speaking learners showed improvement in production of Korean stops, which is opposed to P4. It needs be recalled here that results from the perception task was conformed to P4.

As results from the production task differ from those from the perception task concerning EP1, FP1 and P4, the following section will focus on discussing the dissociation of perception and production in adult L2A.

5.3. Dissociation of Perception and Production in Adult L2A?

As the L2 data of utterance-initial stops collected from the English- and Finnish-speaking subjects have demonstrated that perception is independent of production; before moving onto the next stage, it is worth briefly discussing the discrepancy of perception and production in L2A.

It is undoubtedly accepted that perception precedes production in child language acquisition. For example, Eimas (1975) reported that infants as young as two and three months old were found to discriminate the /r/-/l/ contrast. This finding clearly indicates perception of the liquid contrast preceding production of the contrast which generally takes place between 3-6 years of age (Sander 1971). This assumption that perception precedes production has appeared to influence ideas in L2 research. In the area of second language acquisition, it has been reported that the perception and production are related to each other in the sense that the better the subjects perceived the target pronunciation, the better they were at producing it. (Flege 1981; Major 1987; Champagne-Muzar, Schneiderman & Bourdages 1993; Meador, Flege & MacKay 1999; Flege, Bohn & Jang 1997) On the other hand, there have been also studies which claim that production is

independent of perception especially in second language acquisition. (Bever 1981, Sheldon and Strange 1982, Smith 2000 and 2001)

To address the issue of the relation between perception and production, I draw attention to Flege and Eefting (1987) and Flege (1993), which specifically investigated perception and production of stop segments by the identical subjects, first. Then, several studies reporting on the acquisition of /r/ and /l/ by Japanese speakers will be introduced. Lastly, I attempt to provide reasons for the dissociation of perception and production in the present study.

5.3.1. Perception and Production of Stops

Flege and Eefting (1987) investigated production of /p, t, k/ and /b, d, g/ and perception of /t/ and /d/ by Spanish and English speakers. The Spanish-speaking subjects were divided into three groups according to the age at which they started learning English. The native Spanish children in the group designated "bilingual children (BC)" were 8-9 years old born in Puerto Rico of native Spanish parents, who had attended a private English-speaking school in their native country for an average of 3.6 years. The adult subjects in the group designated "later childhood bilinguals (LCB)" were born and raised in Puerto Rico of native Spanish parents and had never lived in an English-speaking environment. They began learning English at the age of 5-6 years upon entering a private elementary school where they were enrolled for an average of 7.1 years. The adult subjects in the group designated "earlier childhood bilinguals (ECB)" were born in the mainland U.S.A. or had been taken there shortly after birth. The subjects in this group had lived for an average of 9.7 years in the U.S.A. and were enrolled for 6.4 years in an

English-speaking elementary school there. The mean age of both Spanish adult groups were 19 years old, and all the subjects in the groups were enrolled in a Spanish-speaking university at the time of testing. The Spanish speakers of English were compared to monolingual English subjects. The subjects in the group designated "English children (EC)" were 9-10 years old, and those in the group designated "English adults (EA)" were 26 years old on average. None of them in either native English group had been exposed to any language other than English. Results from Flege and Eefting's experiment are summarised in (5.3).

(5.3) /t/-/d/ boundaries perceived and VOT values (ms) of /p, t, k/ produced by the Spanish- and the English-speaking subjects in Flege and Eefting (1987)

	BC	EBC	LBC	EC	EA
Perception	33	27	29	30	43
Production	51	75	57	79	94

If we look at the perceptual VOT values of adult Spanish speakers in (5.3), EBC and LBC do not show significant difference. If perception is related to production, the results from production of /p, t, k/ by the two groups should appear similar to each other. However, VOT values produced by EBC were significantly closer to EA than LBC. Yet, this example dimly implies that perception and production could not be correlated. As there are no studies dealing with relation between adult L2 perception and production of stops in the utterance-initial position to my knowledge, Flege (1993) is taken as the next example in order to discuss the discrepancy of perception and production in adult L2A.

Flege (1993) conducted four experiments, all of which focused on Chinese subjects' perception and production of the contrast between /t/ and /d/ in the word final position of English words (e.g. *beat-bead* and *bat-bad*). The details of the five subgroups of subjects are summarised in (5.4).

(5.4) Details of the Chinese-speaking subjects in Flege (1993)

Group	Age	NOS	LOR	AOA
Inexperienced Mandarin late learners	35.0	10	1.1	34.0
Inexperienced Taiwanese late learners	28.4	10	1.2	27.6
Experienced Taiwanese late learners	30.5	10	5.1	25.4
Childhood L2 learners	21.2	9	12.7	8.3
Native English speakers	25.6	10	--	--

Age: chronological age, in years, NOS: number of subjects, LOR: length of residence in the U.S., in years, AOA: age of arrival in the U.S., in years

The statistical analysis demonstrated that the pattern of significant and non-significant between-group differences were in support of his hypothesis that L2 production accuracy is limited by the adequacy of perceptual representations for sounds in the L2. However, data for individual subjects appeared different, and Flege stated as below:

> Data for individual subjects were not consistent with the "perception before production" hypothesis. As many late learners showed large production effects in the absence of large perception effects as showed large perceptual effects of vowel duration without producing large vowel duration differences. ... Individual data obtained in the present study might be interpreted to mean that success in producing a vowel L2 contrast is not, as

> some claim (e.g. Flege 1988a, 1992 a, b), limited by the extent to which perceptual representations have developed. (Flege 1993: 1605)

In fact, long before Flege (1993), a similar relationship was reported by Brière (1966) for adult English-speaking subjects learning Arabic, French and Vietnamese segments. He included word-initial /t/ and /t'/ in the experiment. The subjects consisted of twenty graduate and undergraduate students attending University of California at Los Angeles and ranging in age from 18 through 26 years. They were monolingual speakers of American English. Based upon his observation that production of sounds always preceded perception of sounds in the data collected from the subjects, he argued that perceptual mastery is not necessarily a causative factor in the acquisition of productive skills.

5.3.2. Perception and Production of /r/ and /l/

There are more recent studies found which report the better performance for production than for perception in the acquisition of English /r/ and /l/ by Japanese speakers. Sheldon and Strange's (1982) empirical study reported that Japanese speakers' production of English /r/ and /l/ contrast was more native-like in their production than their perception. They tested six adult Japanese learners of English, who were enrolled at a university in the U.S.A. One of them graduated from high school in Japan, and the rest of them graduated from a college or a university in Japan. The subjects ranged in age from 19 to 31 years old, with an average age of 26.0 years. Four subjects had resided in the U.S.A. for 14-15 months and the other two for 33 and 39 months. All the subjects started English language instruction in junior high school in Japan and continued through

college. Five subjects had studied another foreign language in addition to English. Some of the subjects reported that they had been taught to pronounce English /r/ and /l/ by explicit reference to articulatory parameters rather than to auditory cues. Sheldon and Strange tested perception and production of /r/ and /l/ in four positions in the word; word-initial prevocalic position, word-initial stops consonant + liquid prevocalic clusters, intervocalic medial position and word-final postvocalic position.

Sheldon and Strange's observation remains consistent with the comparison[21] of Brown's (2000)[22] perceptual study and Riney and Flege's (1998) productive study. Brown's 35 Japanese subjects were divided into two groups, 20 in the low level aged 19 years in average and 15 in the high level aged 24.5 years in average. The low-level subjects had studied English for 7.6 years and the high-level subjects for 11.5 years. All of them were learning English as a foreign language at Hokkaido University, Japan and had never lived in an English-speaking country. Both levels of Japanese learners of English in Brown's perceptual experiments performed very poorly. There was no difference between the low level and high level groups in their ability to discriminate the contrast of /l/ and /r/. For the /l/ and /r/ discrimination, those in the low-level performed approximately 25% of the time correctly and those in the high-level approximately 33% of the time correctly on the auditory experiment. Accordingly, she concluded that Japanese speakers do not improve in the /l-r/ discrimination over time.

[21] I avoid comparing two different types of studies on L2A of stops, most of which adopt acoustic measurements of VOT values. VOT values of the identical stop can vary according to each study; therefore, it may not be appropriate to compare perception of stops with production of stops in two separate studies.

[22] Brown (2000) conducted three experiments involving different sets of Japanese subjects. However, only the experiment which is most similar to Riney and Flege (1998) is mentioned in this section.

On the other hand, Riney & Flege's (1998) longitudinal study based on production experiments also reported that no significant improvement was found for word-initial /l/ and /r/ productions. The interval between the first and second test was separated by 42 months, and the experiments were conducted on 11 native Japanese speakers at the International Christian University in Tokyo, Japan. In the first test, all 11 subjects were the first-year students aged 18-20 years. At the second test, they were all in the fourth year of the university. Except for one subject who had attended local schools in the Philippines for a year, the others had neither lived abroad nor had formal education in English at school. For the /l/ production, the subjects performed 73% of the time correctly in the first test and 87% of the time correctly in the second test, which was conducted 42 months after the first test. And for the /r/ production, they performed 37% of the time correctly in the first test and 53% of the time correctly in the second test. Although production of /r/ was not successful, production of /l/ in Riney and Flege (1998) appeared significantly more successful than discrimination of /r/-/l/ in Brown (2000). Considering the successful production on /l/, there could be another reason for such poor production of /r/ other than poor perception of /r/.

5.3.3. Dissociation of Perception and Production in Adult L2A

Now we consider results that the English- and the Finnish-speaking subjects achieved in the auditory task for perception and the picture naming task for production in the present study, which are illustrated in (5.5). Different from the general belief that perception precedes production in language acquisition, (5.5) shows that there is no such correlation between perception and production in the adult L2 acquisition of Korean stops.

Even though it may appear that production was more successful than perception in terms of the total percentage correct, production was not always more successful than perception with regard to separate results of the three distinctive types of stops.

(5.5) Comparison of perception vs. production of utterance-initial Korean stops

		Aspirated	Plain	Tense	Total Percentage Correct
English	Perception	65.81	53.85	82.91	67.52
	Production	86.32	95.73	63.25	81.77
Finnish	Perception	55.56	60.00	72.59	62.72
	Production	86.51	98.41	76.98	87.30

The same sort of observations contradicting to the general belief was recently discussed by Smith (2000, 2001). Based on data from Japanese and Korean speakers' perception and production of /r/ and /l/ (cf. Sheldon and Strange 1982, Goto 1971, Borden et al. 1983), Smith (2000 and 2001) contended that perception and production of new phonemic contrasts are two separate processes which must be acquired separately, and as such learners can master one process without ever mastering the other. Moreover, Bever (1981) claimed that the systems of speech perception and production were independent entities in the adult mind, in accordance with which he hypothesised speech perception and production developed independently in adult L2A. Bever (1981) supported his claim in three kinds of considerations[23]; the conflicting needs of the speaker

[23]His considerations were not grounded in phonological theories or empirical experiments. He stated that the three arguments were 'general, technical and anecdotal'. Still, I suppose that Bever's hypothesis is

and listener, the perception and production systems using different kinds of behavioral processes and examples of sentences that are unusable productively but not perceptually, and vice versa.

However, I assume that perception must precede production in the completely natural language acquisition environment such as in child language acquisition because no phonemic sound that one has not been exposed to would be impossible to be produced as a language behavior. However, in adult L2A, particularly when orthography is involved, the process of learning foreign phonemes can be different. Young-Scholten (1995: 113) remarked that orthographic input relates to the acquisition of phonology in much the same way that grammatical explanations relate to the acquisition of syntax. Orthographic evidence can in a sense be classified as explicit evidence. As late L2 learners of Korean, the English- and the Finnish-speaking subjects could not avoid the explicit instruction of the Korean orthography in the very beginning of exposure to the Korean language. Although they might not be able to perceptually identify the three distinctive Korean stops, the three different written symbols indicate that they must pronounce the symbols in three different sounds. Obviously, L2 learners' perception of the L2 is not as complete as native speakers', but it seems that they are able to catch target forms of foreign sounds (although not always), based upon which they improve their pronunciation by practice. Regarding a similar concept, Borden, Adele and Gray (1983: 516) noted that the ability to perceive errors in one's own speech (not the ability to correctly perceive native speakers' speech) might precede correct production for learning

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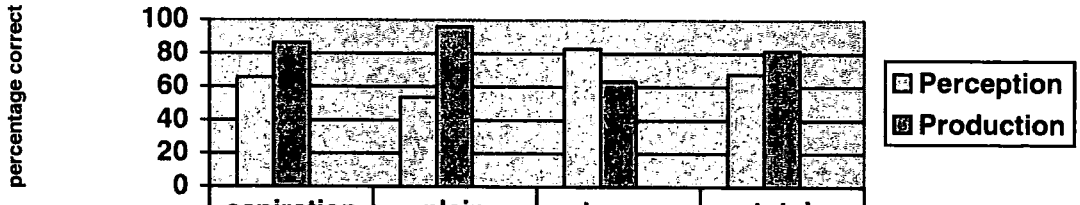
worthwhile noting here in this section in contrast with studies which support the correlation between perception and production.

new phonemes and that improvement in self-perception might be a prerequisite to improvement in production.

Like the subjects in previous studies mentioned above, all subjects in the present study started learning Korean in the classroom environment, and all of them except for one English-speaking subject, E-13 were first exposed to Korean in their native countries. Also, their amount/length of exposure to natural input of Korean is not considered any more sufficient than the natural input that subjects in the other studies introduced in this section had had. In summary, I assume that the reason why production has appeared more successful, in general, than perception in this study may be due to the explicit instruction (e.g. orthographic influence), late age of learning and short amount/length of exposure to natural input of the target language. These three factors may lead the systems of speech perception and production to be independent entities in the mind in L2A as Bever (1981) noted.

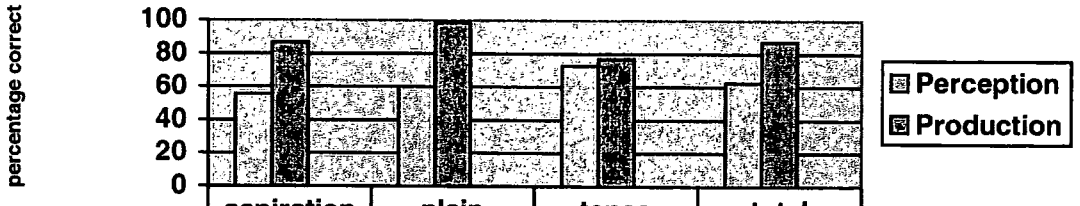
Now, we are going to look at data collected from the task of 'Reading Compounds' to discuss the L2A of the tensification and the intervocalic voicing rules in the following section.

5.3.1. Perception vs. Production by English learners



	aspiration	plain	tense	total
Perception	65,81	53,85	82,91	67,52
Production	86,32	95,73	63,25	81,77

5.3.2. Perception vs. Production by Finnish learners



	aspiration	plain	tense	total
Perception	55,56	60	72,59	62,72
Production	86,51	98,41	76,98	87,3

5.4. Tensification vs. Intervocalic Voicing

In this section, the Korean stops, as the allophonic variations of plain stops constrained by syntax, are examined. Particularly, the allophonic variation resulted from the Korean-specific tensification rule is examined in contrast with that resulted from the universally-distributed intervocalic voicing rule. In the previous sections, Korean stops in word-initial position were investigated in both perception and production. However, the allophonic variations are looked at only in production here. This is because testing perception of Korean stops at word boundaries would be no more than a test in which the learners distinguish between tensed and voiced stops. It is very possible that the learners perceive the difference between those two allophones simply as that between unaspirated voiceless stops and voiced stops. That is, it is possible that English-and Finnish-speaking learners use the feature [+voice] in their L1 in discerning the allophonic variations of a plain stop. In that case, it will be very difficult to know whether the discernment in the perception has been influenced from the learners' L1 features or resulted from the acquisition of the tensification rule and the intervocalic voicing rule in Korean.

The original intention was to analyse the scores on the tensification rule alone to examine its acquisition by English- and Finnish-speaking learners of Korean in comparison with the scores on translation of the compounds used for the task of reading flash cards. I presumed that it would be possible to determine the learners' interlanguage knowledge about the Korean-specific tensification rule through their performance on the twenty compound words involving tensification. I expected that the subjects would be trapped in one of the following four predictions:

- Acquisition of tensification, if they consistently produce the target pronunciation.
- Tendency for intervocalic voicing, if they consistently produce voiced stops for tensified allophones.
- Unsettled stage between tensification and intervocalic voicing, if they produce tense stops and voiced stops for the target form with the similar frequencies to each other.
- Orthographic influence, if they consistently produce plain stops for tensified allophones.

However, the scores on distracters are also analysed in order to compare them with the scores on tensification. I suppose that by doing so, we may gain a better insight for the L2 acquisition of the Korean tensification by English and Finnish speakers. Accordingly, results from the task of reading compounds are presented in three separate parts of 'Tensification', 'Intervocalic Voicing' and 'Nonce Words', focusing on the following aspects; individual results, developmental stages and comparison of English- and Finnish-speaking subjects' performance.

5.4.1. Individual Results and Developmental Stages

Individual results of the English- and Finnish-speaking subjects are provided in Tables 5.4.1 to 5.4.6. 'Tensification', 'Voicing' and 'Other' on the top of the tables refer to the possible process for the variations of underlying plain stops. 'Other' represents the sound judged as either a plain stop or an aspirated stop. In fact, except for two aspirated stops produced by an English-speaking subject, E-4, the rest in column 'Other' were all

judged as plain stops. The numbers in each of the columns are raw numbers of sounds that the learners produced as the result of one of the three processes. Along with the raw numbers, the numbers of correct answers from the translation task were presented in brackets. Also, mean percentages were provided at the bottom of each level of the subgroups (i.e. 'Inexperienced I', 'Inexperienced II' and 'Experienced') to see if L2 Korean learners make a developmental progress in acquiring the tensification rule. This time, the Finnish-speaking subject, F-11 did not participate in the compound reading and translation task.

5.4.1.1. The Tensification Rule

Individual results do not seem to show that the success of the performance on tensification is related to the developmental stage, although results from translation of the same compounds used in reading flash cards apparently is. It does not even seem that it is related to the learners' knowledge of the meaning of a compound. For example, the English-speaking subject, E-1 in the group of 'Inexperienced I' produced the target pronunciation correctly twelve times out of twenty trials although only two of his/her answers in the translation task were correct. On the contrary, another English-speaking subject, E-13 in the group of 'Experienced' shows the opposite. He/She was able to produce the allophonic variation just four times correctly out of twenty tokens regardless of fifteen correct answers in the translation task. This paradox is found among the Finnish-speaking subjects, too as we see the cases of F-3, F-7, F-8, F-9, F-10, F-12, F-13, and F-14 in Table 5.4.2. On the other hand, the scores that other subjects such as E-3, E-8, E-9, F-1, F-6, and F-15 achieved for the reading task are almost equal to those for the

translation task. Hence, they may look to be proposing that the correct production for tensification can be dependent on the knowledge of the syntactic information of a compound. Except for the Finnish-speaking subject, F-15 in the group of 'Experienced', however, the correct pronunciations from their speech data do not one-to-one match the correct answers in the translation task (See Tables 5.4.7-5.4.10 in Appendix for details). Hinted by the individual results lacking consistency, it is not surprising that both language groups of the subjects do not show any apparent evidence that they make progress in the acquisition of the Korean tensification rule in accordance with the developmental stage, despite the fact that apparent developmental progress is observed in translation of the compounds. In production of tensed allophones, the English- and Finnish-speaking subjects achieved 23% and 37% for the group of 'Inexperienced I', 13% and 25% for the group of 'Inexperienced II' and 50% and 40% for the group of 'Experienced', respectively. As for translation of the compounds, the English- and the Finnish-speaking subjects achieved 17% and 24% for the group of 'Inexperienced I', 48% and 75% for the group of 'Inexperienced II' and 81.67% and 86.25% for the group of 'Experienced', respectively. It is very interesting to note that results of the production are not associated with results of the translation. Thus, it is likely that the knowledge of the syntactic relation of compounds may not affect production of the allophonic variation constrained by syntax; that is, the learners may not have acquired the ability to weave the syntactic constraint with the phonological rule, interfering the two grammatical components (i.e. syntax and phonology).

Table 5.4.1. English speakers' performance on tensification (Total 260 tokens)

		Tensification (Translation)	Voicing	Other
Inexperienced I	E-1	12 (2)/20	7	1
	E-2	1 (1)/20	10	9
	E-3	6 (5)/20	6	8
	E-4	1 (0)/20	1	18
	E-5	4 (9)/20	5	11
Mean		24% (17%)	29%	37%
Inexperienced II	E-6	3 (0)/20	4	13
	E-7	4 (9)/20	13	3
	E-8	7 (8)/20	7	6
	E-9	16 (16)/20	4	0
	E-10	10 (15)/20	2	8
Mean		40% (48%)	30%	30%
Experienced	E-11	13 (16)/20	1	6
	E-12	13 (18)/20	1	6
	E-13	4 (15)/20	5	11
Mean		50% (81.67%)	11.67%	38.33%
Total		94 (114)/260	66	100
Mean		36.15% (43.85%)	25.38%	38.46%

Table 5.4.2. Finnish speakers' performance on tensification (Total 280 tokens)

		Tensification	Voicing	Other
Inexperienced I	F-1	12 (10)/20	0	8
	F-2	0 (3)/20	0	20
	F-3	19 (6)/20	0	1
	F-4	1 (2)/20	6	13
	F-5	5 (3)/20	10	5
Mean		37% (24%)	16%	47%
Inexperienced II	F-6	12 (13)/20	1	7
	F-7	4 (15)/20	11	5
	F-8	1 (14)/20	15	4
	F-9	6 (17)/20	1	13
	F-10	2 (16)/20	12	6
Mean		25% (75%)	40%	35%
Experienced	F-11	--	--	--
	F-12	7 (20)/20	11	2
	F-13	4 (16)/20	11	5
	F-14	1 (14)/20	12	7
	F-15	20 (19)/20	0	0
Mean		40% (86.25%)	42.5%	17.5%
Total		94 (168)/280	90	96
Mean		33.57% (60%)	32.14%	34.29%

5.4.1.2. The Intervocalic Voicing Rule

The paradox that the L2 learners revealed between the compound reading and the translation tasks in the performance for tensification exists in the performance for the intervocalic voicing rule as well. Most of the subjects in the both language groups of 'Inexperienced I' produced voiced sounds without knowing the meanings of the compounds, so did E-6 and E-8 in the English-speaking group of 'Inexperienced II'. The opposite cases are also found such as E-12 in the English-speaking group and F-9 in the Finnish-speaking group. Because the number of tokens is small, it is difficult to know whether the rest of the subjects produced voiced sounds with assistance of the syntactic knowledge of 'Determiner /Adjective + Noun' structure. Still, it is inferred from the paradoxical cases that the relation between the voiced pronunciation and the syntactic knowledge for the intervocalic voicing rule may not be in accord in the learners' mind yet, as in the acquisition of the tensification rule. The frequencies of voiced sounds may coincidentally appear similar to those of correct translated answers. As for developmental progress, it is not clear that the L2 learners are genuinely making progress with the Korean intervocalic voicing rule, considering that the English group of 'Inexperienced II' attained higher scores for intervocalic voicing than any other groups (i.e. 68% for the group of 'Inexperienced I', 88% for the group of 'Inexperienced II' and 80% for the group of 'Experienced'), although the Finnish-speaking subjects show clear developmental progress on the intervocalic voicing rule (i.e. 40% for the group of Inexperienced I', 68% for the group of Inexperienced II' and 90% for the group of 'Experienced'). As for the translation, the English- and the Finnish-speaking subjects

achieved 12% and 0% for the group of 'Inexperienced I', 48% and 76% for the group of 'Inexperienced II' and 73.33% and 80% for the group of 'Experienced', respectively.

Table 5.4.3. English speakers' performance on intervocalic voicing (Total 65 tokens)

		Tensification	Voicing	Other
Inexperienced I	E-1	0	5 (0)/5	0
	E-2	0	4 (0)/5	1
	E-3	0	4 (0)/5	1
	E-4	0	0 (0)/5	5
	E-5	0	4 (3)/5	1
Mean		0%	68% (12%)	32%
Inexperienced II	E-6	0	4 (0)/5	1
	E-7	0	5 (4)/5	0
	E-8	0	5 (1)/5	0
	E-9	0	4 (3)/5	1
	E-10	0	4 (4)/5	1
Mean		0%	88% (48%)	12%
Experienced	E-11	0	5 (3)/5	0
	E-12	2	2 (5)/5	1
	E-13	0	5 (3)/5	0
Mean		13.33%	80% (73.33%)	6.67%
Total		2	51 (26)/65	12
Mean		3.08%	78.46% (40%)	18.46%

Table 5.4.4. Finnish speakers' performance on intervocalic voicing (Total 70 tokens)

		Tensification	Voicing	Other
Inexperienced I	F-1	1	0 (0)/5	4
	F-2	0	0 (0)/5	5
	F-3	1	4 (0)/5	0
	F-4	0	2 (0)/5	3
	F-5	0	4 (0)/5	1
Mean		8%	40% (0%)	52%
Inexperienced II	F-6	0	3 (3)/5	2
	F-7	0	5 (4)/5	0
	F-8	0	5 (4)/5	0
	F-9	1	0 (4)/5	4
	F-10	0	4 (4)/5	1
Mean		4%	68% (76%)	28%
Experienced	F-11	--	--	--
	F-12	0	5 (4)/5	0
	F-13	0	5 (4)/5	0
	F-14	0	5 (4)/5	0
	F-15	2	3 (4)/5	0
Mean		10%	90% (80%)	0%
Total		5	45 (35)/70	20
Mean		7.14%	64.29% (50%)	28.57%

5.4.1.3. Nonce Words

Not only five intervocalic voicing forms but also four nonce words and one POT (Post Obstruent Tensing) form were seeded as distracters in the task of reading flash cards. The number of tokens is too small to draw a conclusion; however, for the performance on nonce words, results of each individual subject differ without forming a particular pattern of tendency. In terms of the development stage, we see neither progress nor regression. The percentages that the English-speaking subjects scored for 'tensification' are 35% at the level of 'Inexperienced I', 30% at the level of 'Inexperienced II' and 41.67% at the level of 'Experienced'. The Finnish-speaking subjects' percentages attained for tensification are 45% at the level of 'Inexperienced I', 20% at the level of 'Inexperienced II' and 43.75% at the level of 'Experienced'. The percentages of 'intervocalic voicing' appear as random as those of tensification regarding the developmental stage. The English-speaking subjects produced voiced sounds for nonce words 25% of the time at the level of 'Inexperienced I', 55% of the time at the level of 'Inexperienced II' and 16.67% of the time at the level of 'Experienced', and the Finnish-speaking subjects 15% of the time at the level of 'Inexperienced I', 45% of the time at the level of 'Inexperienced II' and 31.25% of the time at the level of 'Experienced'. For 'other', the English-speaking subjects' results remain as unsystematic as those of 'tensification' and 'intervocalic voicing' whilst the Finnish-speaking subjects produced the fewer of 'other' sounds (i.e. plain stops) for the allophonic variation as the level goes higher; 40% of the time at the level of 'Inexperienced I', 35% of the time at the level of 'Inexperienced II' and 25% of the time at the level of 'Experienced'.

Table 5.4.5. English speakers' performance on nonce words (Total 52 tokens)

		Tensed	Voiced	Other
Inexperienced I	A	3	1	0
	B	0	2	2
	C	2	0	2
	D	0	0	4
	E	2	2	0
Mean		35%	25%	40%
Inexperienced II	F	1	2	1
	G	0	4	0
	H	1	3	0
	I	3	1	0
	J	1	1	2
Mean		30%	55%	15%
Experienced	K	2	2	0
	L	2	0	2
	M	1	0	3
Mean		41.67%	16.67%	41.67%
Total		18	18	16
Mean		34.62%	34.62%	30.77%

Table 5.4.6. Finnish speakers' performance for nonce words (Total 56 tokens)

		Tensed	Voiced	Other
Inexperienced I	F-1	3	0	1
	F-2	0	0	4
	F-3	4	0	0
	F-4	0	1	3
	F-5	2	2	0
Mean		45%	15%	40%
Inexperienced II	F-6	2	1	1
	F-7	1	3	0
	F-8	0	4	0
	F-9	1	0	3
	F-10	0	1	3
Mean		20%	45%	35%
Experienced	F-11	--	--	--
	F-12	2	2	0
	F-13	1	1	2
	F-14	0	2	2
	F-15	4	0	0
Mean		43.75%	31.25%	25%
Total		20	17	19
Mean		35.71%	30.36%	33.93%

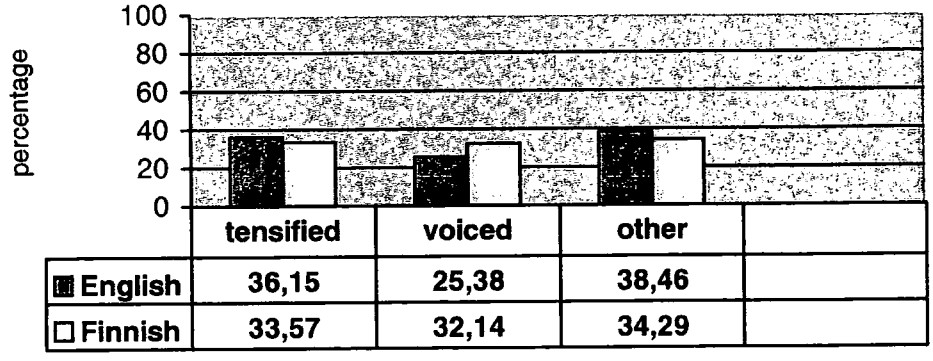
5.4.2. Comparison of the Two Language Groups

Results from the English- and Finnish-speaking groups' production are illustrated in Figures 5.4.1, 5.4.2 and 5.4.3. Generally speaking, results from both groups superficially look very similar to each other.

5.4.2.1. The Tensification Rule

The mean percentage for tensification of the English-speaking group is 36.15% within a range of 5% to 80% and that of the Finnish-speaking group is 33.57% within a range of 0% to 100%. As a group, learners in both groups almost identically achieved very low scores for 'tensification', and they also achieved very similar error rates for 'intervocalic voicing' and 'other' to each other; 25.38% vs. 32.14% and 38.46% vs. 34.29% (the English- vs. the Finnish-speaking subjects), respectively.

Figure 5.4.1. Performance on tensification

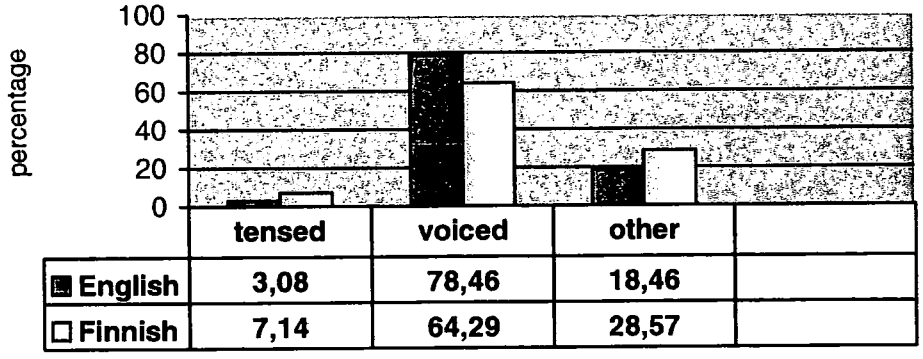


	tensified	voiced	other	
English	36,15	25,38	38,46	
Finnish	33,57	32,14	34,29	

5.4.2.2. The Intervocalic Voicing Rule

As for the intervocalic voicing rule, both the English- and the Finnish-speaking subjects performed most successfully for 'intervocalic voicing', demonstrating significantly high rates of target-like pronunciation, as we see in Figure 5.4.2. They both not only achieved the highest scores for 'intervocalic voicing' but also scored the lowest rates for 'tensification' with similar figures. The English subjects performed 78.46% of the time correctly for 'intervocalic voicing' and made errors 3.08% of the time for 'tensification' and 18.46% of the time for 'other'. On the other hand, the Finnish subjects performed 64.29% of the time correctly for 'intervocalic voicing' and made errors 7.14% of the time for 'tensification' and 28.57% of the time for 'other'.

Figure 5.4.2. Performance on intervocalic voicing

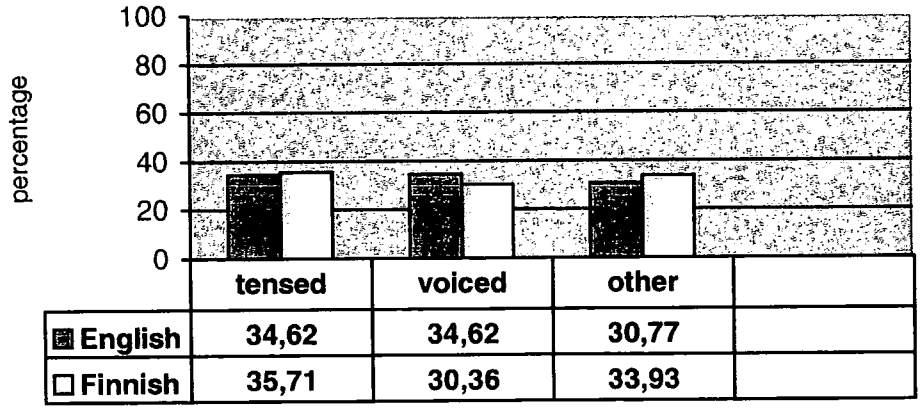


	tensed	voiced	other	
English	3,08	78,46	18,46	
Finnish	7,14	64,29	28,57	

5.4.2.3. Nonce Words

Results from both of the English- and the Finnish-speaking subjects show that their production data for nonce words are distributed very evenly over all the possible three types of the allophonic variation; 34.62% vs. 35.71% for 'tensification', 34.62% vs. 30.36% for 'intervocalic voicing' and 30.77% vs. 33.93% for 'other' respectively.

Figure 5.4.3. Performance on nonce words



So far, results from the task of reading flash cards have been presented in figures, divided into three parts; 'the tensification rule', 'the intervocalic voicing rule' and 'nonce words'. The figures are analysed through discussion in consideration of factors which could affect the acquisition of the allophonic variation of the Korean plain stop in the following section.

5.4.3. Discussion

In order to discuss the outcome of the English- and the Finnish-speaking subjects' performance on the Korean phonological rules, two questions below are focused for the analysis of results:

- Why did the English- and the Finnish-speaking subjects unexpectedly perform similarly to each other for the task of reading compounds despite the fact that their L1s are very different from each other? Do the similar percentages correct for the tensification rule (i.e. 36.15% for the English-speaking subjects and 33.57% for the Finnish-speaking subjects) achieved by the two language groups mean that they share similar competence for the Korean-specific rule with each other?
- How could the L1 orthographies influence the acquisition of the tensification rule by the English- and the Finnish-speaking subjects respectively, since a 'reading' task was provided?

In Section 3.5, Chapter 3, it was predicted that English speakers would not be successful in acquiring the tensification rule owing to lack of its relevant grammar in their L1 while Finnish speakers would be due to presence of geminates and gemination in Finnish. However, the score achieved by the English-speaking subjects is very close to that of the Finnish-speaking subjects, who were expected to benefit from their L1.

With the assistance of Young-Scholten (1997), I attempt to provide an explanation for this ironic phenomenon. In her study, she investigated the acquisition of cliticisation in German by English speakers and found evidence that the syntactic conditions were not being learned by the advanced learners, most of whom were students

at a German university. Still, she assumed that the learners were in process of acquiring cliticisation in German and expected that 'even extremely advanced learners would exhibit a departure from the path of acquisition followed by the learners in the study' (cited from Young-Scholten 1997: 209).

Neither English- nor Finnish-speaking subjects at any of the three levels in the present study are as advanced in Korean as the English-speaking subjects in Young-Scholten's (1997) study were in German. Hence, it is very difficult to suppose that the L2 learners of Korean had acquired or had embarked on learning the relationship between the phonological rule and syntactic conditions at the time of testing. Still, it seems that in accordance with the amount of exposure to primary linguistic data (PLD), the learners develop the ability to produce the form of the allophonic variation simply as the target sound although they might not have gained the knowledge of how to relate the tensification rule to the syntactic condition. This is inferred from the gradual increase of the percentages correct made by the subjects for the tensification rule; the English-speaking subjects demonstrate 24% for the group of 'Inexperienced I', 40% for the group of 'Inexperienced II' and 50% for the group of 'Experienced' for target-like production. Presumably, this developmental progress may be more related to their L1 feature [+voice] rather than their L2 knowledge of the phonological rule in Korean.

Yet, the Finnish-speaking subjects in the group of 'Inexperienced I' (37%) achieved higher scores than the group of 'Inexperienced II' (25%) although the group of 'Experienced' (40%) attained the highest score. I presume that it is because the subject F-3 is exceptional in his group. It was the third time that he returned to the same course, since he had not managed to finish the course the last two times. Excluding his data, the

rate becomes 22.5%, the lowest score among the Finnish subgroups. On the other hand, the 'Experienced' learners also recorded the highest rates for 'tensification' in the performance of the words applying to the intervocalic voicing rules (13.33% for the English-speaking subjects and 10% for the Finnish-speaking subjects) and in the performance on nonce words (41.67% for the English-speaking subjects and 43.75% for the Finnish-speaking subjects). Despite all these relatively higher rates for 'tensification' than for 'intervocalic voicing' and 'other', the actual percentages correct for the tensification rule, appearing very low, allow us to conclude that the L2 subjects in both English- and Finnish-speaking groups have not yet acquired but may be possibly in process of learning the Korean-specific rule. I assume that not having the knowledge of the relation between the tensification rule and the syntactic condition of the 'N + N' compound yet, both language groups of learners are facing the same difficulty in learning Korean; however, those who are aware of the tensified sounds in Korean compounds may regard tensifying the allophonic variation as simply producing an unaspirated voiceless stop (which can be heard as a Korean tense stop by native Korean speakers) in the intervocalic position rather than as a result of gemination at their stage of learning Korean.

To summarise, my data are in accordance with Young-Scholten's (1997), and I assume that Finnish speakers should be able to complete the acquisition of the tensification rule as the Subset Principle predicts (see Section 3.4.2.2), according to which the superset grammar is more general and generates all the sentences and forms that the more restrictive subset generates as well as additional sentences or forms. Hence, I assume that although positive L1 transfer is available, it may take considerably more

time to acquire phenomena where there is a subtle interface between syntax and phonology in adult L2 phonology.

It is also worth paying attention to the percentages correct on the performance on the intervocalic voicing rule. Recalling the unsuccessful performance on the tensification rule, it may be possible to claim with the higher percentages correct (78.46% for the English-speaking subjects and 64.92% for the Finnish-speaking subjects) that acquisition of the intervocalic voicing rule precedes the tensification rule. However, we have to carefully examine the forms applying to the intervocalic voicing rule. We should take into account that L2 learners of Korean are explicitly taught that native Korean number modifiers such as *han* 'one' and *twu* 'two' are never used independently but must accompany a noun following them. On the other hand, *cinan* 'last' is a modifying form of the verb *cinata* 'to pass'. The learners must know that it is not a noun but a modifier because they are taught in class that the present tense modifier derived from a verb always takes the morpheme '*-(n)(u)n*'. Due to this explicit teaching and the reading of examples for practice in the classroom, L2 learners of Korean may easily learn the intervocalic voicing phenomenon in Korean. Moreover, the forms of *pan+tal* 'half moon' and *sen+palam* 'strong wind', as their first parts end in *n*, could be mistakenly viewed to have the modifying morpheme by the learners. The point is that the voicing which occurred in the learners' data can be the result from a general phonological rule (or from the universal application of intervocalic voicing) in the learners' mind created based upon the explicit instruction[24] in Korean, and it should not be taken as the evidence that they have the knowledge of the relation between the phonological rule and syntactic

[24] Schwartz (1993) argues that explicit evidence cannot act on linguistic competence because metalinguistic knowledge and linguistic competence are separately encapsulated in the mind.

condition for intervocalic voicing in Korean. In addition, the higher frequency of usage of the words (particularly, *han* 'one', *twu* 'two' and *cinan* 'last') with the noun, *tal* 'month' could be a part of the reason why the learners appear to be so successful with the intervocalic voicing rule. Possibly the choice of items (as distracters for the intervocalic voicing rule) was inadequate in this study. However, because intervocalic voicing is not the main issue in the present study which is to investigate the acquisition of the tensification rule, I will not go further into it here.

Now, we turn to the orthographic factor in the acquisition of the tensification rule. Young-Scholten (1995) argues that orthographic input can have negative effects in adult L2 phonology. She remarks that even when the learner receives native-accented, non-teacher-talk PLD, the potential for positive evidence to have negative consequences still exists due to orthographic input. She adds that premature exposure to orthographic input (at or near the initial stages of L2 phonological development) can be expected to impede progression to native phonological competence in the L2 (Young-Scholten 1995: 112). Bearing her remarks in mind, we look at the English-speaking subjects' data for 'other' first. Owing to the loose relation between written symbols and sounds, English speakers were predicted to not be heavily influenced by the Korean orthography in Chapter 3 (see EP3). Then, why did they still make errors so frequently for 'other'? Also, why did the error rate not accord with the developmental stages except for the case of performance on the intervocalic voicing words? I assume that the reason lies in the influence from their L1 phonological rules regarding stop segments as well as the fact that English lacks geminates and gemination. In the segmental production task, the same English-speaking subjects were the least successful in producing tense stops among the three types of

Korean stops and showed a higher tendency to produce tense stops as aspirated stops in utterance-initial position. However, as English aspirated stops in word-medial position are weakened (Cooper 1991)[25], I assume that the English-speaking subjects weakened the Korean stops at the word boundary in compounds as they do in their L1. The weakened stops produced in the place of the allophonic variation could have been heard as plain stops by the native Korean judge[26] so that they appear to have read the allophonic variation as written on the flash cards. Alternatively, it is possible that they were not able to produce the allophonic variation as a resyllabified geminate (in other words, as the result of gemination) because their L1 lacks both geminates and gemination. In this case, they could have read the two adjacent words by following their L1 grammar, which does not change the quality of word-initial stop sounds at word boundaries. Therefore, it is not surprising that the English-speaking subjects, including those in the group of 'Experienced', demonstrated such high rates for 'other' due to non-orthographic influence in the performance on tensification and nonce words; and this can be taken as the evidence to support EP3.

As for the performance on intervocalic voicing, it can be regarded as natural for the English-speaking subjects to be judged as 'other' less often in accordance with the developmental stage. It is because they do not have the same problem of absence of a certain L2 grammar in their L1 with intervocalic voicing as they do with tensification. Thus, the English-speaking subjects' rates for 'other' in their performance on intervocalic voicing may not have been affected by the factors we considered for their performance on

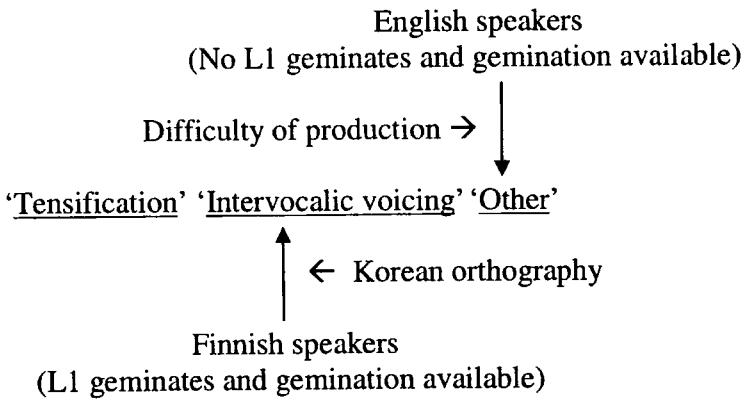
[25] Cooper (1991) found that English voiceless aspirated stops in word-initial position have a larger glottal opening gesture compared to word-medial position. If the glottis opens more, and takes longer to do so, the VOT is likely to be longer as well (Cho and Keating 2001: 181).
[26] See the assumed ranges of VOT values in (5.1) in Section 5.2.4 for the reason of the statement.

the tensification rule. They managed to successfully voice the stops, producing allophonic variation although this can be due to an interlanguage phonological rule that may not be necessarily identical to native Korean phonological competence in which the interaction between phonological rules and syntactic conditions is much more complicated.

On the other hand, the Finnish-speaking subjects show gradual decrease of the rates for 'other' in performance for all three categories (i.e. the tensification rule, the intervocalic voicing rule and nonce words), according to the developmental stage. I consider this phenomenon to show developmental progress in learning the nature of Korean orthography, which is constrained by phonological rules differently from Finnish. In terms of dissociating letters from sounds, development clearly appears to be occurring. This progress, however, does not mean that they are overcoming the orthographical influence to produce the target allophonic variation caused by the tensification rule. Rather, it seems to hinder them from pronouncing the symbol of a plain stop as a tensified sound. In Korean, voiced sounds do not have corresponding letters, appearing only as an allophonic variation of the plain stop phonemes. In other words, the letter for a plain stop symbolises both voiced sounds in the intervocalic position and slightly aspirated sounds in the utterance-initial position whereas the letter for a tense stop symbolises only tense stop sounds. Being aware of this aspect of the Korean orthography, the 'experienced' Finnish-speaking subjects in the group might have produced the allophone as a voiced sound significantly more often than the 'experienced' English-speaking subjects in the performance on the tensification rule. Presumably that is one of the reasons why they do not appear to have taken advantage of their L1

geminates and gemination in the acquisition of the tensification rule. In summary, I present a model to visually help the understanding of the L2 learners' performance on the tensification rule as in (5.6).

(5.6) A model of the L2 learners' performance on the tensification rule



Finally, results from performance on the tensification rule appeared very different from those from the task of producing utterance-initial stops. Rather, they look more similar to results from the performance on nonce words. This may be due to the position of the stops. That is, the Korean stop phonemes had to be produced in the utterance-initial position in the picture naming task, but on word boundaries in the task of reading compounds. I assume that it might be equally difficult for English speakers to produce Korean tense stops in both positions because their L1 does not have geminates at all. On the other hand, although the Finnish-speaking subjects struggled to produce word-initial tense stops as the English-speaking subjects did, it might not be difficult for them to produce word-internal geminates because word-internal geminates do exist and gemination occurs across word boundaries in Finnish. Yet, they seem to be negatively

influenced by the written symbol of the allophone in the acquisition of the tensification rule as FP3 predicted, and it is not clear whether they are able to link the Korean phonological rule with its correct syntactic condition.

5.4.4. Summary

In Chapter 3, we predicted that Finnish speakers would more successfully perform on the Korean tensification rule than English speakers owing to L1 transfer (see EP2 and FP2 in Section 3.5). However, results supported only EP2 and failed to support FP2, showing that the two language groups performed equally poorly on the tensification rule. According to the results, both English- and Finnish-speaking learners showed improvement on the tensification rule over time, which is opposed to the prediction P5 suggested in Section 3.5, Chapter 3. One reason was that the subjects in both groups are not advanced enough to sense the interaction between the phonological rule and syntactic condition in the Korean grammar; hence, it was presumed that despite different L1 backgrounds, they were facing the same challenge of learning the Korean-specific rule in their beginning stage of learning. Another reason was orthographic influence. It was inferred from results for 'intervocalic voicing' and 'other' that the English- and the Finnish-speaking subjects, reflecting the relation between sounds and letters in L1, might have taken different routes to produce stops subject to the tensification rule. In conclusion, regardless of the two language groups' similarly poor results in performance on the tensification rule, only Finnish speakers were concluded to have acquired the Korean-specific rule, due to positive L1 transfer occurring at their even advanced stages of learning.

6. Summary and Conclusions

The purpose of this thesis is to find the reason why mastering L2 pronunciation is extremely difficult in adult L2A. I have taken a purely linguistic approach to find it under the hypothesis that the acquisition of segmental phonology is more than the physical matter of getting the articulators to move correctly and involves phonological rules and principles. The hypothesis was tested through the L2A of Korean stops by English- and Finnish-speaking adults, which was investigated in three parts; perception of stop segments in word-initial position, production of stop segments in word-initial position and production of stops involving phonological rules constrained by syntax (i.e. the tensification rule vs. the intervocalic voicing rule). In particular, the complexity of phonological rules interfering more than one grammatical components (particularly mapping the syntax to the phonology) was described with regard to the prosodic hierarchy proposed by Nespor and Vogel (1982, 1986) in Chapter 1.

Before investigating the adult L2A of Korean stops, review of previous studies on L2A of phonemes were followed in Chapter 2. Particularly, followings were brought to our special attention so that results of this study would be analysed and discussed in consideration of them: Brown's (1998, 2000) for the issue of perception of segments; Flege and Hillenbrand (1984), Flege (1986) and Flege and Eefting (1987) for the issue of production of segments; and Young-Scholten (1994, 1997) for the issue of prosodic/postlexical phonological rules constrained by syntax.

In Chapter 3, the general outline of Korean stops was provided in comparison with English and Finnish stops, focusing on phonological representations, VOT values

and relevant phonological rules constrained by syntax (i.e. the tensification rule and the intervocalic voicing rule). The implications for the L2A of Korean stops by English and Finnish speakers were also discussed so that following predictions were suggested with respect to the learners' L1 background.

Predictions for English-speaking learners:

- English speakers will be confused in the distinction of the three distinctive types of Korean stops (i.e. aspirated, plain and tense) due to lack of the feature [spread glottis] and double-timing slots (XX) in their L1 grammar.
- No L1 transfer will occur in English speakers' acquisition of the Korean tensification rule due to a lack of geminates or gemination in English.
- English speakers will not be influenced by the Korean orthography due to the concept of a loose relationship between spellings and sounds in their L1.

Predictions for Finnish-speaking learners:

- Finnish speakers will be confused in the distinction of the three distinctive types of Korean stops (i.e. aspirated, plain and tense) like English speakers because they lack the feature [spread glottis] and double-timing slots (XX) in word-initial position in their L1 grammar.
- Finnish speakers will acquire the Korean tensification rule for the 'N+N' compounding because Finnish gemination is more restricted than Korean gemination.
- Finnish speakers will be heavily influenced by the Korean orthography because of the tight relationship between spellings and sounds in their L1.

In addition, predictions regarding development in the L2A of Korean stops by both English- and Finnish-speaking learners were suggested with regard to previous studies on L2A of phonology.

Predictions for development in the L2A of Korean

- In consideration of Brown (1998, 2000), it is predicted that English- and Finnish-speaking learners will not show development in the L2A of word-initial Korean stops because their L1 stops lack the feature [sg] and double-timing slot in word-initial position.
- In consideration of Young-Scholten (1994), it is predicted that Finnish-speaking learners will show development in the acquisition of the tensification rule under the Subset Principle.

In the experiment described in Chapter 4, the task of 'segmental discrimination' was provided to examine the perception of stop segments in word-initial position, the task of 'picture naming' to examine the production of stop segments in word-initial position and the task of 'reading flash cards' to examine the production of stops involving phonological rules constrained by syntax.

In Chapter 5, results from the experiment were discussed. Firstly, as for perception of stop segments in word-initial position, both English- and Finnish-speaking learners performed better in discerning geminates from non-geminate segment in general. Especially, the two language groups of learners were native-like in discerning a geminate (AA) from a non-geminate of which the segment is different from the ones in the geminate (B). On the contrary, the Korean stops distinguished by the feature [sg] alone have appeared the most difficult for the L2 learners of Korean to acquire. The English- and Finnish-speaking learners showed a similar pattern of difficulties in discerning Korean stops regarding the feature [sg]; however, differences between the two language groups were also found in the perception of word-initial Korean stops, which were caused by the absence or presence of geminate in the learners' L1. On the other hand, no

progress was made by English- and Finnish-speaking learners in the acquisition of Korean stops in accordance with the developmental levels.

Secondly, not only phonological representations but also VOT values were examined for production of stop segments in word-initial position. Although the L2 data from the task of 'picture naming' were judged by a Korean native speaker, the production of word-initial stop segments appeared more successful than the perception of them. However, because Korean native speakers categorically hear stop sounds, it was not possible to know if VOT values of Korean stops produced by the L2 learners were native-like (Major 1987) or if they remained intermediate to the phonetic norm for VOT in L1 and L2 (Flege 1987). The difficulty in producing word-initial stops seemed to be caused by Korean-particular phonological representations rather than controlling the degree of VOT values. Otherwise, the Finnish-speaking learners would have been far more successful than the English-speaking learners in the production of Korean tense stops which are pronounced in the similar manner of articulation and with the VOT values as their unaspirated voiceless stop. As for the developmental aspect, English- and Finnish-speaking learners showed the improvement in the segmental production task according to the developmental levels unlike in the segmental perception task.

The dissociation between the perception and production of word-initial Korean stops in the experiment of the present study was briefly discussed in consideration of other studies on adult L2 phoneme acquisition (Bever 1981, Flege and Eefting 1987, Flege 1993, Sheldon & Strange 1982, Smith 2000 and 2001). Although it is undoubtedly accepted that perception precedes production in child language acquisition, production does not always seem to be dependent on perception in L2A. In addition, Young-

Scholten (1995), which examines orthographic influence in L2A, was considered for the issue of the dissociation between perception and production. It was concluded that the Korean orthography (explicit instruction for the pronunciation of the three types of stops based on the different orthographic symbols), age of learning (late adult L2A) and amount/length of exposure (that was too short to experience the development of perception) to the target language could be the factors that resulted in the dissociation between perception and production in this study.

Thirdly, opposed to the prediction for the tensification rule, the English- and Finnish-speaking learners performed equally poorly on the tensification rule despite the differences in their L1s. One reason was that the learners in both language groups were not advanced enough to sense the interaction between the phonological rule and syntactic condition in the Korean grammar. Another reason was orthographic influence. It was inferred from the results for 'intervocalic voicing' and 'other' that the English- and Finnish-speaking learners might have taken different routes to produce stops subject to the tensification rule, supporting the predictions regarding the loose or tight relationship between sounds and orthographic letters in their L1s. Regardless of the two language groups' similarly poor results in performance on the tensification rule, it was presumed that only Finnish speakers would be able to acquire the Korean-specific rule with the supposition that positive L1 transfer might occur at the even advanced stages of learning.

In the light of these findings summarised above, we can, therefore, conclude that the hypothesis of this thesis has been supported by results from the experiment. Considering that the Finnish-speaking learners did not perform any better on Korean tense stops, of which VOT values are almost identical to unaspirated voiceless stops in

their L1 than the English-speaking learners, L2A of pronunciation is not only a physical matter but is more related to the mental representations even for a segment in word-initial position; I believe that this is supported better by a cross-sectional study than a longitudinal study with a smaller number of research subjects, particularly considering that no acoustical equipment was used in the present study. If a subject in a longitudinal study has a certain type of personal tendency in production of stops (e.g. producing stops with smaller VOT values than the norm) or is persistent with a certain type of unsurfaced articulatory habit which exists in his or her L1 as well as L2, the validity of the study will remain in question because the entire data is not regarded reliable.

Observing that the L2 learners had far greater difficulty in their production of stops involved in the tensification rule constrained by syntax than in their production of word-initial stops, it is concluded that the difficulty of mastering L2 phonology is due to the complexity of phonological rules applying beyond the component of phonology or across phonological domains in the prosodic hierarchy, some of which provide a means for mapping the syntax to the phonology. All the complex phonological rules and principles of a segment must be acquired for the target pronunciation.

APPENDIX

1. The task of segmental discrimination

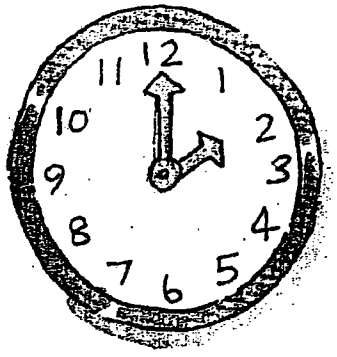
Matching the Identical Phonemes

		A	B	C	Not sure
1	ka	ka	k^ha	k'a	
2	p^ha	pa	p'a	p^ha	
3	ta	t^ha	ta	t'a	
4	k^ha	k'a	ka	k^ha	
5	pa	p'a	pa	p^ha	
6	t'a	t^ha	t'a	ta	
7	k'a	k'a	k^ha	ka	
8	p'a	pa	p'a	p^ha	
9	t^ha	ta	t^ha	t'a	
10	t'e	te	t^he	t'e	
11	pe	p^he	p'e	pe	
12	k^he	ke	k^he	k'e	
13	te	t^he	t'e	te	
14	p^he	p'e	p^he	pe	
15	ke	k^he	ke	k'e	
16	t^he	t'e	t^he	te	
17	p'e	p'e	p^he	pe	
18	k'e	ke	k'e	k^he	
19	k^hu	ku	k^hu	k'u	
20	pu	pu	p'u	p^hu	
21	t'u	t^hu	tu	t'u	
22	k'u	k'u	k^hu	ku	
23	p'u	p^hu	p'u	pu	
24	t^hu	tu	t^hu	t'u	
25	ku	ku	k^hu	k'u	
26	p^hu	p'u	pu	p^hu	
27	tu	t'u	tu	t^hu	

2. The task of picture naming

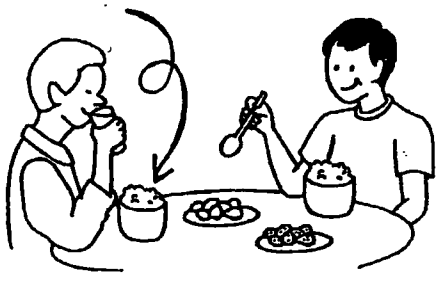
2.1. The material

1.



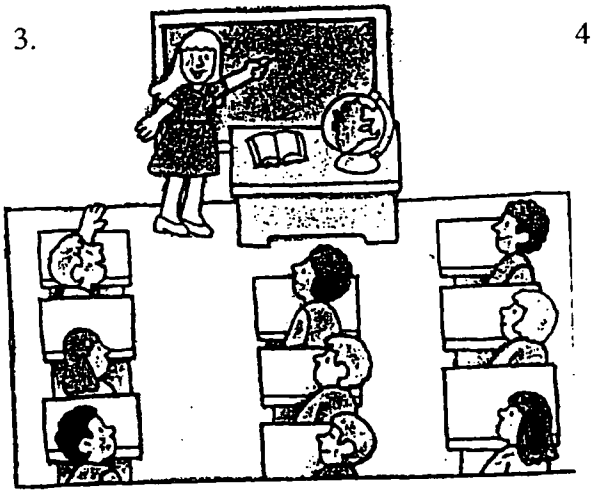
two o'clock

2.



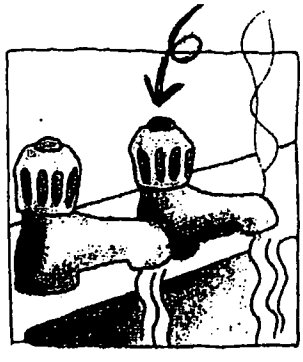
boiled rice

3.



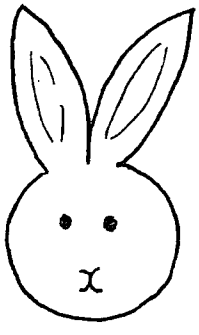
to teach

4.



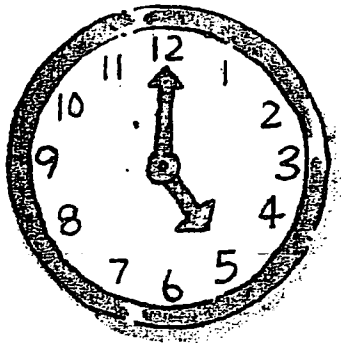
hot

5.



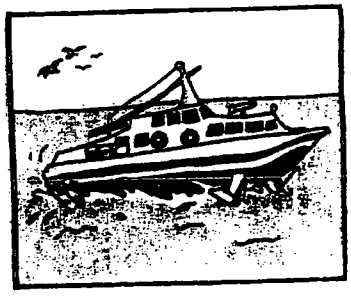
rabbit

6.



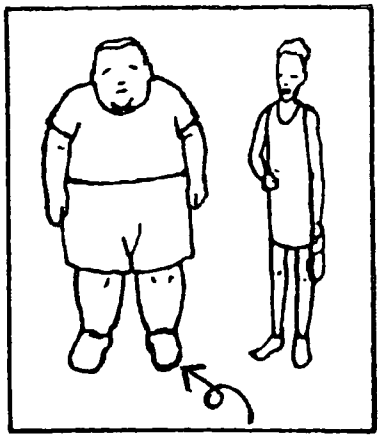
five o'clock

7.



ship/boat

8.

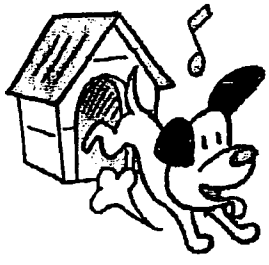


fat

9.

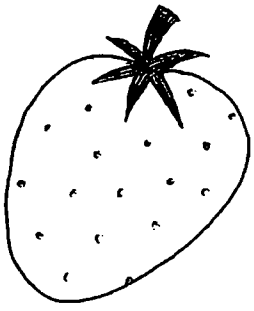
rain

10.



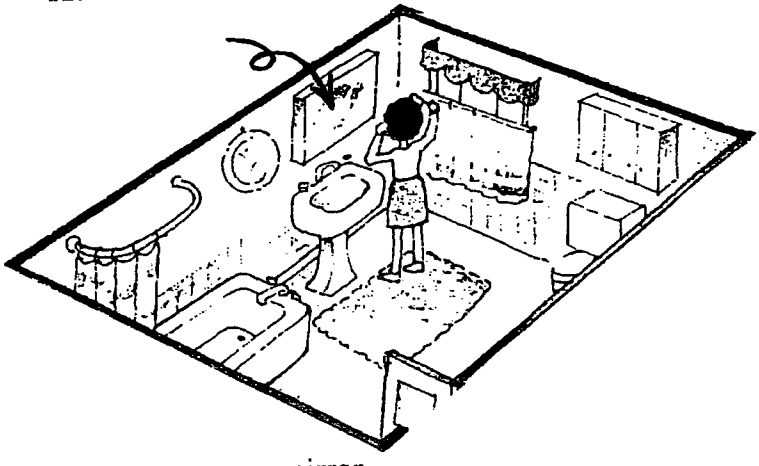
dog

11.



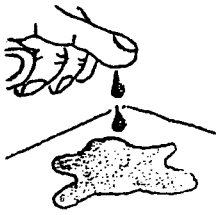
strawberry

12.



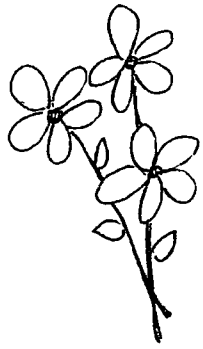
mirror

13.



blood

14.



flower

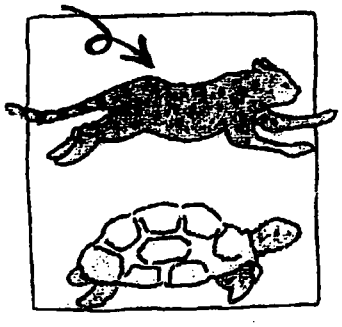
15.

to get on

16.

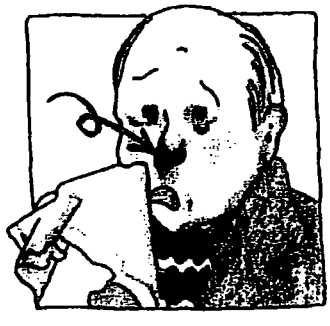
hot

17.



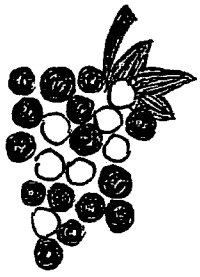
fast

18.



nose

19.



grapes

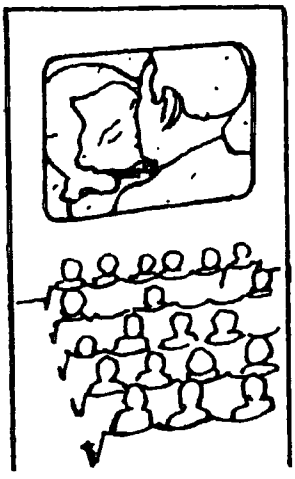
20.

chin

21.

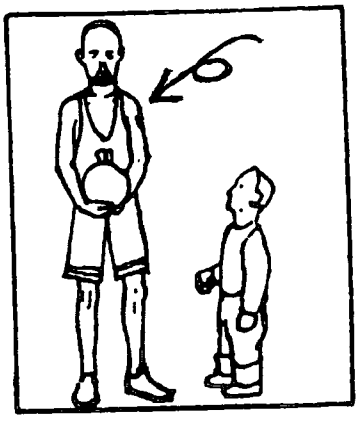
honey

22.



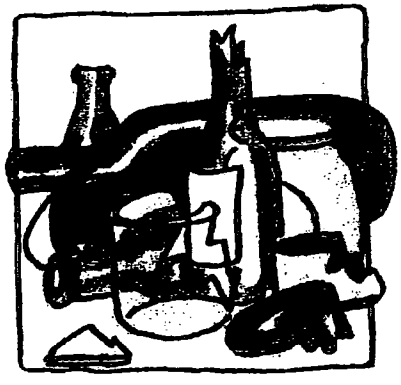
to kiss

23.



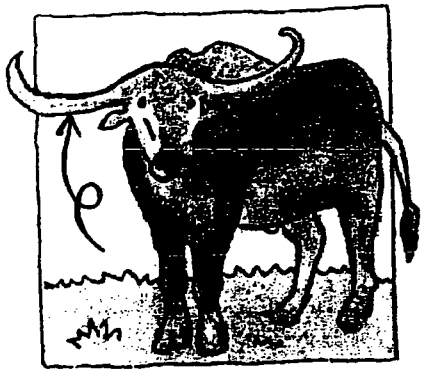
tall

24.



broken

25.

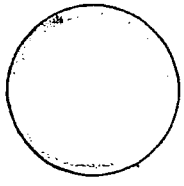


horn

26.

knife

27.



blue

2.2. Lexical items

Words beginning with aspirated stops:

1.	khal	'knife'
2.	khika kheyo	'to be tall'
3.	kho	'nose'
4.	thayo	'to get on (the bus)'
5.	thokki	'rabbit'
6.	thek	'chin'
7.	phalansayk	'blue'
8.	photo	'grapes'
9.	phi	'blood'

Words beginning with plain stops:

1.	kalucheyyo	'to teach'
2.	kay	'dog'
3.	kewul	'mirror'
4.	tasessi	'five o'clock'
5.	twusi	'two o'clock'
6.	teweyo	'to be warm'
7.	pap	'rice'
8.	pay	'ship'
9.	pi	'rain'

Words beginning with tense stops:

1. kkoch 'flower'
2. kkwul 'honey'
3. kkayceysseyo 'to be broken'
4. ttalki 'strawberry',
5. ttwungttwunghayyo 'to be fat'
6. ttukeweyo 'to be hot'
7. ppallayo 'to be fast'
8. ppoppohayyo 'to kiss'
9. ppwul 'horn'

3. The task of reading flash cards (or compounds)

Tensification (1-20):

1. taum /t/al [t']
   next month
   'next month'

2. ipen /t/al [t']
   this month
   'this month'

3. chosung /t/al [t']
   early month moon
   'crescent'

4. polum /t/al [t']
   half of the month moon
   'full moon'

5. nayil /p/am [p']
   tomorrow night
   'tomorrow night'

6. onul /p/am [p']
   today night
   'tonight'

7. ecey /p/am [p']
   yesterday night
   'last night'

8. kang /p/alam [p']
   river wind
   'river by/from the river'

9. kaul /p/alam [p']
   autumn wind
   'autumn wind'

10. kyewul /p/alam [p']
    winter wind
    'winter wind'

11. pom /p/alam [p']
spring wind
'spring wind'

12. kwail /k/akey [k']
fruit shop
'fruit shop'

13 kwutwu /k/akey [k']
shoe shop
'shoes shop'

14. kapang /k/akey [k']
bag shop
'bag shop'

15. chayso /k/akey [k']
vegetable shop
'vegetable shop'

16. nayngmyen /k/ulus [k']
cold noodle bowl
'a bowl for cold noodles'

17. mwul /p/yeng [p']
water bottle
'water bottle'

18. maykcwu /p/yeng [p']
beer bottle
'beer bottle'

19. yong /t/on [t']
for use money
'pocket money'

20. ton /k/apang [k']
money bag
'money bag'

Distracters (21-30):

21. kkoch /p/yeng [p'] : Post-Obstruent Tensing
flower bottle
'vase'

22. cinan /t/al [d] : Intervocalic Voicing
last month
'last month'

23. pan /t/al [d] : Intervocalic Voicing
half moon
'half moon'

25. twu /t/al [d] : Intervocalic Voicing
two month
'two months'

26. sen /p/alam [b] : Intervocalic Voicing
fresh wind
'strong wind'

27. chayso /p/am : Nonce word
vegetable night

28. polum /p/alam : Nonce word
mid month wind

29. chosung /k/akay : Nonce word
early month shop

30. kapang /t/on : Nonce word
bag money

4. Questionnaire

CONSENT TO PARTICIPATE IN RESEARCH

Second Language Acquisition of Korean Stop Phonemes

- **PURPOSE OF THE PROJECT**

The purpose of the project is to explore the development of adult L2 learners' acquiring Korean stop phonemes.

- **PROCEDURES**

The materials will be used for the perception and production tasks by your regular teachers. Your production will be audio-recorded so that we can examine the quality of your production of Korean stops.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this project and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law.

- **PARTICIPATION AND WITHDRAWAL**

You can choose whether to participate in this project or not. If you volunteer to participate in this project, you may withdraw at any time without consequences of any kind. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

- **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about the research, please feel free to contact Miss Jeong-Young Kim +358 (0)9 191 22790, jeong-young.kim@helsinki.fi.

- **SIGNATURE**

My questions have been answered to my satisfaction, and I agree to participate in this project. I have been given a copy of this form.

Name of Subject	Signature of Subject	Date

In my judgment the subject is voluntarily and knowingly giving informed consent and possesses the legal capacity to give informed consent to participate in this project.

Name of Investigator	Signature of Investigator	Date

1. What is your mother tongue?

2. What do/did you study at the university?

3. What other languages do you speak? (Don't specify Korean here)

language	period of learning (from -to)	how many hours a week	where	level

4. Where and how long did you learn Korean or have you been learning Korean?

5. Have you been to Korea? How many times? How long did you stay in Korean each time?

5. Error classifications

Tables 5.1.3, 5.1.4 and 5.1.5: Subjects are labelled with numerical digits. Labels of subjects are marked according to the error type. For example, if a subject made an error matching stimulus [k^h] with plain stop [k], the label of the subject has been marked in the box on the row of [k^h] and under the column of 'Plain'.

Table 5.1.3. Misperceptions in identifying aspirated stops

	Plain		Tense		Not sure	
	Eng	Finn	Eng	Finn	Eng	Finn
[k^ha]	3, 5, 7, 13	1, 4, 5, 6, 8, 10, 15	11		8	2
[k^he]	7, 9, 10	1, 2, 3				
[k^hu]	3, 5, 6, 7, 8, 10, 11, 13	1, 3, 4, 5, 7, 14, 15				
[t^ha]	9, 10, 11, 13	1, 4, 5, 8, 9, 11			5, 6	2, 6, 7, 10, 13, 14, 15
[t^he]	10, 11	2, 3, 8, 15			9	
[t^hu]	3, 5, 9, 11	1, 3. 4, 9, 15				8, 14
[p^ha]		1. 7, 8 15			5	
[p^he]		3, 5, 6, 7			4, 5	4
[p^hu]	3, 4, 5, 7, 8, 11	1, 2, 4, 5, 7, 8, 10, 14			9	6
Number of errors	31	48	1	0	8	12
Error rate (%)	77.5	80.00	2.50	0	20.00	20.00

Table 5.1.4. Misperceptions in identifying plain stops

	Aspirated		Tense		Not sure	
	Eng	Finn	Eng	Finn	Eng	Finn
[ka]		13	12	10	7	2
[ke]	3, 4, 5, 6, 10, 12, 13	1, 2, 3, 13	8	11	9	5, 6, 8, 15
[ku]	1, 3, 5, 6, 8, 13	1, 11, 13, 14	9, 10		4	5
[ta]	1, 4, 11	1, 2, 3, 9, 14	12, 10		5	4, 5
[te]	8		5, 4, 6, 11	13, 11	9	1, 2, 5, 7, 10, 15
[tu]	8	1, 2, 4, 6 15	3, 4, 5, 13	12		13
[pa]	2, 3, 4, 8		7, 12	12	9	11
[pe]	4	4		2		15
[pu]	2, 3, 4, 5, 6, 9, 10, 13	1, 2, 4, 6, 7, 9, 10, 13	8			5, 14
Number of errors	31	28	17	7	6	19
Error rate (%)	57.41%	51.85%	31.48%	12.96%	11.11%	35.19%

Table 5.1.5. Misperceptions in identifying tense stops

	Aspirated		Plain		Not sure	
	Eng	Finn	Eng	Finn	Eng	Finn
[k'a]				3, 10	9, 13	2, 4
[k'e]	4, 8, 12			10		5, 7
[k'u]	8		10	8, 15	4, 11	7, 13
[t'a]			2, 3, 6, 8, 10, 13,	8, 13	5	5, 7
[t'e]		1, 8, 11, 14	11	3		
[t'u]	5			1, 3, 13		5
[p'a]				2, 3, 8, 11, 13		
[p'e]				11		7, 10, 13
[p'u]	8		12	5, 12, 13		10
Number of errors	6	4	9	20	5	13
Error rate (%)	30.00	10.81	45.00	54.05	25.00	35.14

Tables 5.2.3, 5.2.4 and 5.2.5: Labels of subjects are marked depending on the error types in the tables. For example, if a subject made an error by producing [ka] for aspirated stop [k^ha], the label of the subject has been marked in the box on the row of [k^h] and under the column of 'Plain'.

Table 5.2.3. Errors in producing aspirated stops

Target pronunciation	Plain		Tense	
	Eng	Finn	Eng	Finn
k^ha			4	11
k^hi			4	2, 4, 11
k^ho	6		4	2, 4, 11
t^ha		2		
t^ho	5, 6, 7, 11	2, 6, 9		7
t^he		13		2, 11
p^ha	6			3, 6, 7, 11
p^ho	6	2	4	
p^hi	5, 6, 7, 8, 10	4, 9		11
No. of Errors	12	8	4	15
Error rate (%)	75.00	34.78	25.00	65.22

Table 5.2.4. Errors in producing plain stops

Target pronunciation	Aspirated		Tense	
	Eng	Finn	Eng	Finn
[ka]				
[kæ]			10	11
[k]	2			11, 15
[ta]				2
[tu]	4			11
[t]	4			
[pa]				11
[pæ]				
[pi]	4			
No. of errors	4	0	1	6
Error rate (%)	80.00	0.00	20.00	100

Table 5.2.5. Errors in producing tense stops

Target pronunciation	Aspirated		Plain	
	Eng	Finn	Eng	Finn
[k'o]	5	1, 2	2, 8, 12	5
[k'u]	1, 2, 3, 4, 8	1, 2	6, 10	5
[k'æ]	2, 3, 7, 9	1, 8	6	
[t'a]	1, 4, 8	1, 3	5, 7, 10	2, 4, 13
[t'u]	1	1, 4	8	
[t']	3, 4, 5, 7	1, 3, 8, 14	8	2, 5
[p'a]	1, 2, 4, 5, 8	1, 2, 3, 8	3, 6	13
[p'o]	1, 4, 13	1		
[p'u]	1, 3, 4, 8	1, 2		
No. of errors	30	31	13	13
Error rate (%)	69.77	70.45	30.23	29.55

Tables 5.4.7-5.4.10: Labels of subjects are marked depending on the type of the sound produced in the position of allophone. For example, if a subject produced [k'a], the label of the subject has been marked under the column of tensification. The numbers on the left side in the tables refer to the corresponding words listed in the beginning of the appendix. Besides that, sounds judged as aspirated are marked with *.

Table 5.4.7. English speakers' performance on tensification

	Tensification	Voicing	Other
1	9, 11, 12	1, 2. 3, 7, 8, 10, 13	4*, 5. 6
2	3, 6, 9, 12	1, 2, 7, 8, 10	4, 5, 11, 13
3	3, 9, 10, 11, 12	1, 5, 7, 8, 13	2, 4, 6
4	1, 8, 9, 10, 11, 12, 13	2, 3, 7	4, 5, 6
5	1, 5, 7, 8, 9, 11, 12, 13	2, 4	3, 6, 10
6	1, 3, 5, 8, 10, 11, 12	2, 6, 7, 9, 13	4
7	3, 6, 9, 10, 11, 12	1, 5, 7	2, 4, 8, 13
8	11	1, 2, 7, 8, 9, 13	3, 4*, 5, 6, 10, 12
9	2, 9, 10	3, 5, 6	1, 4, 7, 8, 11, 12, 13
10	1, 5, 7, 9, 10		2, 3, 4, 6, 8, 11, 12, 13
11	1, 8, 11, 12	7, 9	2, 3, 4, 5, 6, 10, 13
12	1, 3, 8, 9, 11, 12	5, 7	2, 4, 6, 10, 13
13	1, 9, 11, 12		2, 3, 4, 5, 6, 7, 8, 10, 13
14	9, 11	1, 7, 8, 12	2, 3, 4, 5, 6, 10, 13
15	9, 11	1, 3, 7	2, 4, 5, 6, 8, 10, 12, 13
16	1, 9, 10	8, 11	2, 3, 4, 5, 6, 7, 12, 13
17	1, 4, 8, 10, 12	2, 3, 6, 7, 9, 13	5, 11
18	1, 3, 9, 10, 12, 13	2, 5, 7, 8	4, 6, 11
19	1, 5, 7, 8, 9, 10, 11, 12, 13	2, 3, 6	4
20	1, 6, 7, 9	2	3, 4, 5, 8, 10, 11, 12, 13
Rates (%)	36.15	25.38	38.46

Table 5.4.8. Finnish speakers' performance on tensification

	Tensification	Voicing	Other
1	3, 15	7, 8, 10, 12, 13, 14	4, 5, 1, 2, 6, 9
2	3, 6, 15	4, 5, 7, 8, 10, 12, 13, 14	1, 2, 9
3	3, 5, 6, 15	8, 12,13, 14	1, 2, 4, 7, 9, 10
4	3, 5, 6, 9, 15	7, 8, 10, 12, 13, 14	1, 2, 4
5	1, 3, 5, 6, 12, 13, 15	4, 7, 8	2, 9, 10, 14
6	1, 3, 5, 6, 12, 13, 15	7, 8, 14	2, 4, 9, 10
7	1, 3, 6, 7, 12, 15	5, 8	2, 4, 9, 10, 13, 14
8	1, 3, 6, 7, 9, 15	5, 8, 10, 13, 14	2, 4, 12
9	3, 12, 15	4, 5	1, 2, 6, 7, 8, 9, 10, 13, 14
10	1, 3, 10, 15	5, 7, 13	2, 4, 6, 8, 9, 12, 14
11	1, 3, 15,	4, 5, 7, 8, 9, 10, 12, 13, 14	2, 6
12	1, 3, 7, 15	8, 10, 12, 13, 14	2, 4, 5, 6, 9
13	3, 6, 13, 15	5, 7, 8, 10, 12, 14	1, 2, 4, 9
14	1 3, 4, 15	5, 6, 8, 10, 12, 14	2, 7, 9, 13
15	1, 3, 5, 6, 12, 15	4, 7	2, 8, 9, 10, 13, 14
16	1, 3, 6, 7, 15	5, 10, 12	2, 4, 8, 9, 13, 14
17	1, 9, 12, 15	4, 8, 10, 13, 14	2, 3, 5, 6, 7
18	3, 8, 9, 10, 12, 13, 14, 15		1, 2, 4, 5, 6, 7
19	3, 6, 9, 15	7, 8, 10, 13, 14, 12	1, 2, 4, 5
20	1, 3, 6, 9, 15	5, 7, 8, 10, 12, 13	2, 4, 14
Rates (%)	33.57	32.14	34.29

Table 5.4.9. English speakers' performance on distracters

	Tensification	Voicing	Other
	Intervocalic Voicing		
21	12	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 13	4
22		1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13	4
23	12	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 13	4
24		9, 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13	4
25		1, 7, 8, 11, 13	2, 3, 4, 5, 6, 9, 10, 12
Rates (%)	3.08	78.46	18.46
	Nonce Words		
26	9, 11, 12	1, 5, 6, 7, 8	2, 3, 4, 10, 13
27	1, 5, 6, 8, 11, 12, 13	2, 7, 9, 10	3, 4
28	1, 3, 9	5, 7, 8, 11	2, 4, 6, 10, 12, 13
29	1, 3, 5, 9, 10	2, 6, 7, 8, 11	4, 12, 13
Rates (%)	34.62	34.62	30.77
	Post Obstruent Tensing		
30	1, 4, 5, 6, 7, 8, 9, 10, 12, 13		2, 3, 11
Rates (%)	76.92	0	23.08

Table 5.4.10. Finnish speakers' performance on distracters

	Tensification	Voicing	Other
	Intervocalic Voicing		
21	15	3, 5, 6, 7, 8, 10, 12, 13, 14	1, 2, 4, 9
22	9	3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 15	2, 1
23		3, 5, 7, 8, 10, 12, 13, 14, 15	1, 2, 4, 6, 9
24		3, 5, 6, 7, 8, 10, 12, 13, 14 15	1, 2, 4, 9
25	1, 3, 15	4, 7, 8, 12, 13, 14	2, 5, 6, 9, 10
Rates (%)	7.14	64.29	28.57
	Nonce Words		
26	1, 3, 6, 12, 15	5, 7, 8, 14	2, 4, 9, 10, 13
27	1, 3, 5, 12, 15	7, 8, 10, 14	2, 4, 6, 9, 13
28	3, 5, 7, 15	4, 6, 8, 12, 13	1, 2, 9, 10, 14
29	1, 3, 6, 9, 13, 15	5. 7, 8, 12	2, 4, 10, 14
Rates (%)	35.71	30.36	33.93
	Post Obstruent Tensing		
30	1, 4, 6, 7, 9, 10, 12, 13, 15		2, 3, 5, 8, 14
Rates (%)	64.29	0	35.71

Tables 5.4.11 and 5.4.12: Labels of subjects are marked in each column if the translated answer of the subject is correct. Each number on the left indicates its corresponding word.

Table 5.4.11. Translation task for 'N + 14 compounds

	English	Finnish
1	5, 7, 8, 9, 10, 11, 12, 13	6, 7, 8, 9, 10, 12, 13, 14, 15
2	5, 7, 9, 10, 11, 12, 13	6, 7, 7, 9, 10, 12, 13, 14, 15
3	12	12
4	12	12, 15
5	5, 7, 8, 9, 10, 11, 12, 13	1, 2, 6, 7, 8, 9, 10, 12, 13, 14, 15
6	7, 8, 9, 10, 11, 12, 13	1, 2, 6, 7, 8, 9, 10, 12, 13, 14, 15
7	5, 7, 8, 9, 10, 11, 12, 13	1, 2, 6, 8, 9, 10, 12, 13, 14, 15
8	11	7, 9, 10, 12, 15
9	9, 10, 11, 12, 13	7, 8, 9, 10, 12, 13, 14, 15
10	9, 10, 11, 12, 13	6, 7, 8, 9, 10, 12, 13, 14, 15
11	9, 10, 11, 12, 13	6, 7, 8, 9, 10, 12, 13, 14, 15
12	3, 9, 10, 11, 12, 13	1, 6, 7, 8, 9, 10, 12, 13, 14, 15
13	3, 5, 7, 8, 9, 10, 11, 12, 13	1, 3, 6, 7, 8, 9, 10, 12, 13, 14, 15
14	3, 5, 7, 8, 9, 10, 11, 12, 13	1, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15
15		7, 12, 15
16	1, 9, 10, 11, 12, 13	1, 3, 6, 7, 8, 9, 10, 12, 13, 14, 15
17	3, 5, 7, 8, 9, 10, 11, 12, 13	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15
18	1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15
19	9, 10, 12	9, 12, 13, 15
20	5, 9, 11, 12, 13	1, 3, 9, 10, 12, 13, 15
Percentages correct (%)	31.67	44.21

Table 5.4.12. Translation task for distracters

	English	Finnish
	Intervocalic Voicing	
21	5, 7, 8, 9, 10, 11, 12, 13	6, 7, 8, 9, 10, 12, 13, 14, 15
22	7, 10, 12	7, 8, 9, 10, 12, 13, 14, 15
23	5, 7, 9, 10, 11, 12, 13	6, 7, 8, 9, 10, 12, 13, 14, 15
24	5, 7, 9, 10, 11, 12, 13	6, 7, 8, 9, 10, 12, 13, 14, 15
25	12	
Percentages correct (%)	40	50
	Post-Obstruent Tensing	
30	1, 3, 4, 7, 8, 9, 10, 11, 12, 13	2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15
Percentages correct (%)	76.92	85.71

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